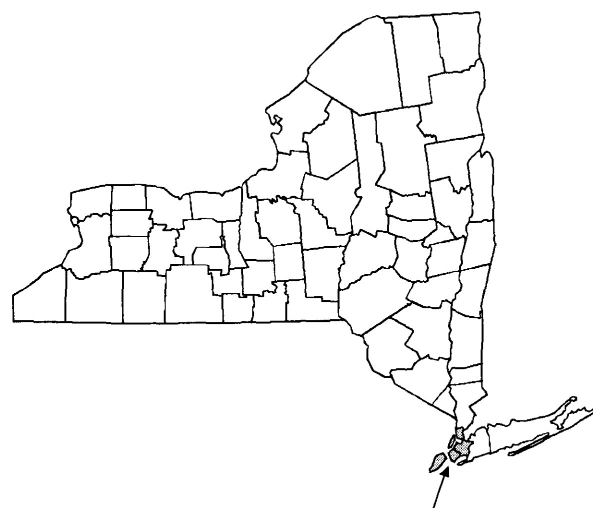
FLOOD INSURANCE STUDY

CITY OF NEW YORK, NEW YORK

BRONX COUNTY, RICHMOND COUNTY NEW YORK COUNTY, QUEENS COUNTY, KINGS COUNTY



REVISED:

SEPTEMBER 5, 2007

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
360497V000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial FIS Effective Date: May 16, 1983 (FIS report);
November 16, 1983 (Flood Insurance Rate Map)

Revised FIS Dates: February 15, 1991
May 18, 1992 (Flood Insurance Rate Map only)
July 5, 1994
May 21, 2001

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

EXHIBITS - continued

FLOOD INSURANCE STUDY
CITY OF NEW YORK,
BRONX, RICHMOND, NEW YORK, QUEENS, AND KINGS COUNTIES,
NEW YORK

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates a previous FIS/Flood Insurance Rate Map (FIRM) for the City of New York, Bronx, Richmond, New York, Queens, and Kings Counties, New York. This information will be used by the City of New York to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

For the original May 16, 1983, FIS and November 16, 1983, FIRM (hereinafter referred to as the 1983 FIS), the hydrologic and hydraulic analyses for Arthur Kill, the Atlantic Ocean, Bronx Kill, the Bronx River, the East River, the Harlem River, the Hudson River, the Hutchinson River, Jamaica Bay, Kill Van Kull, Long Island Sound, Lower Bay, Newark Bay, Raritan Bay, and Upper Bay were prepared by Camp, Dresser and McKee, Inc., under subcontract to the New York State Department of Environmental Conservation (NYSDEC) for the Federal Emergency Management Agency (FEMA), under Contract No. H-4784. That work was completed in December 1981.

For the February 15, 1991, revision, the hydrologic and hydraulic analyses for Ranger Creek were prepared by the New York City Department of City Planning for FEMA. That work was completed in May 1989.

For the July 5, 1994, revision, the hydrologic and hydraulic analyses for Sweet Brook, Colon Tributary, Eltingville Tributary, Arbutus Creek, Jansen Tributary, Denise Tributary, Lemon Creek, and Sandy Brook, were prepared by Leonard Jackson Associates for FEMA, under Contract No. 91-R-3373. That work was completed in June 1992.

For the May 21, 2001, revision, updated topographic information of wetlands within Richmond County only was prepared by the New York City Department of Environmental Protection (NYCDEP). This information was agreed upon with FEMA to be used for the revision.

For this revision, updated topographic information for the City of New York was provided by the City of New York Department of Information Technology and Telecommunication (DOITT) and used to redelineate all detailed flood hazard areas. Additionally, updated hydrologic and hydraulic analyses for the Bronx River, Arbutus Creek, Blue Heron Main, Blue Heron Tributary, Butler Manor, Colon Tributary, D Street Brook, Denise Tributary, Eltingville Tributary, Foresthill Road Brook, Jansen Tributary, Lemon Creek, Mill Creek, Mill Creek Tributary 1, Mill Creek Tributary 2, Mill Creek Tributary 3, Sandy Brook, Sweet Brook, and Richmond Creek were prepared by Leonard Jackson Associates for FEMA, under Contract No. EMN-2003-RP-001.

Base map information shown on the FIRMs was provided by DOITT. This information was derived from digital orthophotography produced at a scale of 1:1,200 with 2-foot pixel resolution from photography dated 2004.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

For the 1983 FIS, an initial CCO meeting was held on August 12, 1976, and a final CCO meeting was held on December 13, 1982. Both of these meetings were attended by representatives of the City of New York; Camp, Dresser and McKee, Inc.; and FEMA.

For the July 5, 1994, study, an initial CCO meeting was held on February 1990 and was attended by representatives of the City of New York, Leonard Jackson Associates, and FEMA.

For the May 21, 2001, revision, a Cooperating Technical Community (CTC) Agreement was made on July 8, 1999, between the Borough of Staten Island and FEMA.

For this revision, an initial CCO meeting was held on April 22, 2004, and was attended by representatives of the City of New York Department of Buildings, DOITT, City of New York Department of Planning, City of New York Office of Emergency Management, Leonard Jackson Associates, Dewberry, and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the incorporated area of the City of New York, Bronx, Richmond, New York, Queens, and Kings Counties, New York.

For the 1983 FIS, the following streams were studied by detailed methods: the Bronx River, the Hutchinson River, the Atlantic Ocean, Raritan Bay, New York Bay (including the Upper Bay, Lower Bay, and the Narrows), Jamaica Bay, Long Island Sound, Little Neck Bay, the East River, the Harlem River, the Hudson River, Arthur Kill, Bronx Kill, and Kill Van Kull.

The February 15, 1991, revision was prepared to map wetlands as 100-year special flood hazard areas along Ranger Creek stream corridors in Richmond County on Staten Island.

For the July 5, 1994, revision, the following streams were studied by detailed methods: Sweet Brook, from its confluence with the Richmond Creek swamplands to Delmar Avenue; Colon Tributary, from its confluence with Sweet Brook to Giffords Lane; Eltingville Tributary, from its confluence with Sweet Brook to the Staten Island Railroad; Arbutus Creek, from the Hylan Boulevard to a point approximately 1,200 feet upstream of Amboy Road; Jansen Tributary, from its confluence with Arbutus Creek to a point near Kingdom Avenue; Denise Tributary, from its confluence with Arbutus Creek to a point near Hogan Avenue; Lemon Creek, from a point approximately 500 feet upstream of Rossville Avenue to Amboy Road for a distance of approximately 1.5 miles; and Sandy Brook, from its confluence with Lemon Creek to a point approximately 500 feet downstream of Sharrotts Road.

For the May 21, 2001, revision, some 100-year (Zone A) floodplains and a portion of the 100-year (Zone AE) floodplain along Eltingville Tributary, from Katan Avenue to a point approximately 200 feet upstream of Wilson Avenue, within Richmond County on Staten Island, were removed and/or redelineated based on updated topographic information (NYCDEP, 1999). The revision also incorporated the following Letter of Map Revisions: 92-02-014P, dated December 24, 1992, to reflect the effects of two completed storm drain projects, which will contain Springville Creek in the vicinity of the Heartland Condominiums II and 98-02-698P, dated May 2, 1999, to modify Special Flood Hazard Areas (SFHAs) near the intersection of Dewey Avenue and Greaves Avenue.

For this revision, some 100-year (Zone AE) and 500-year (Zone X shaded) floodplains were removed and/or redelineated based on updated topographic and base map information (NYC DOITT, 2004).

As part of this FIS, updated analyses were included for the flooding sources shown in Table 1, "Scope of Revision."

TABLE 1 - SCOPE OF REVISION

Amboy Road Wetland	Jacks Pond
Arbutus Creek	Jansen Tributary
Blue Heron Main	Lemon Creek
Blue Heron Tributary	Mill Creek
Bronx River	Mill Creek Tributary 1
Butler Manor	Mill Creek Tributary 2
Cleveland Avenue Wetland	Mill Creek Tributary 3
Colon Tributary	Richmond Creek
D Street Brook	Sandy Brook
Denise Tributary	Stump Pond
Eibs Pond	Sweet Brook
Eltingville Tributary	Wolfes Pond
Foresthill Road Brook	Wood Duck Pond
Hillside Avenue Wetland	

This revision also incorporates the following Letter of Map Revision: 01-02-045P, dated July 3, 2002, to reflect the construction of a rip-rap revetment and slope protection along Prince's Bay.

Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2). The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Several streams were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of New York.

2.2 Community Description

The City of New York is located in southeastern New York State and consists of Bronx County (Bronx Borough), Kings County (Brooklyn Borough), New York County (Manhattan Borough), Queens County (Queens Borough), and Richmond County (Staten Island). The City of New York is bordered to the west and southwest in the State of New Jersey by Sandy Hook, the Towns of Middletown, Union Beach, Cliffwood, Cliffwood Beach, Lawrence Harbor, Sayreville, the City of South Amboy and the Boroughs of Keansburg and Keyport along the southern shore of Raritan Bay; the Cities of Perth Amboy, Linden, Elizabeth and Bayonne, the Township of Woodbridge, and the Borough of Carteret, located west of Staten Island; and the Cities of Jersey City and Hoboken, the Towns of West New York, and Guttenburg, the Townships of Weehawken, North Bergen, and Tenafly, on the west side of the Hudson River. In the State of New York, communities bordering the City of New York to the north include the Cities of Yonkers and Mount Vernon, the Villages of Pelham Manor, Pelham, and New Rochelle. To the east of the city lie the Villages of Great Neck Estates and Atlantic Beach, North Hempstead, and Hempstead. The surface area of the City of New York is 412.3 square miles (27 percent is under water) with a land area of 299.7 square miles. The city has an estimated coastline of 320 miles.

New York City originated in the spring of 1624 when 30 families arrived on Manhattan Island and constructed permanent dwellings on the southern shore, now known as the Battery. By 1700, the population had increased to 5,000. By that time, the docks along the coastline had been filled in with refuse and silt and paved over so that the docks could be extended. By 1800, the population of the city increased to 60,000. Staten Island had a population of 4,500. In 1834, Brooklyn became a city with a population of 24,000. By 1850, the population of New York City, still consisting only of Manhattan, had increased to 515,000. In 1898, greater New York originated the merger of Manhattan with Brooklyn, Staten Island, Queens, and the Bronx. The correct borough name for Richmond County is also Richmond. However, the borough is most commonly referred to as Staten Island, which is used throughout this study. Today, the City of New York is the largest city in the United States and one of the largest cities in the world. The 1980 population of the city was 7,035,348 (U.S. Department of Commerce, 1981). The 1990 population of the city was 7,322,564 . The population of the city increased to 8,008,278 in the 2000 Census (U.S. Census, 2000). The populations of the counties and boroughs in New York are shown in Table 2, "Population and Land Area of New York City."

TABLE 2 - POPULATION AND LAND AREA OF NEW YORK CITY

County	Borough	1980 Census Population	1990 Census Population	2000 Census Population	Land Area (sq. miles)
Bronx	Bronx	1,162,632	1,203,789	1,332,650	42
Kings	Brooklyn	2,218,441	2,300,664	2,465,326	71
New York	Manhattan	1,418,124	1,487,536	1,537,195	23
Queens	Queens	1,886,550	1,951,598	2,229,379	109
Richmond	Staten Island	349,601	378,977	443,728	58

The following brief history of the Rockaway Peninsula and Jamaica Bay will provide some insight as to the reason data regarding the city's coastline and water area should be referenced to a specific time period.

In 1835, Rockaway Point was located near the present east boundary of Jacob Riis Park. East Rockaway Inlet was located 20,000 feet east of its present position, near Long Beach, New York. South of Rockaway Point, a large shoal had formed which was to provide the material for extending this point nearly four miles to the east during the next 100 years. The shoreline generally receded between 1835 and 1878 while, at the same time, Rockaway Point extended two miles westward. Jacob Riis Park acquired its present shoreline during this period.

Between 1878 and 1927, the shoreline of the Rockaways advanced a small amount. Rockaway Point grew rapidly until 1902, but from 1902 to 1927, its westward expansion was only half its previous rate. From 1927 to the present, the shoreline of the Rockaways has been stable. Nearly 12 million cubic yards of sand have been artificially placed east of Rockaway Point since that time.

Within Jamaica Bay, it has been estimated that 150 million cubic yards of material have been dredged in the past 40 years. The most common use for dredged material has been for fill purposes in land reclamation projects. Originally, almost all of the area surrounding Jamaica Bay except the barrier beach to the south was marshland. Today, due to extensive filling, the shoreline around the bay is quite different than it was 40 years ago.

Some of the larger projects in Jamaica Bay during this time were: Floyd Bennet Airfield at Barren Island; the development of the Mill Basin area by private developers; the construction of Canarsie pier; the completion of the Shore Parkway over low-lying marshland; the City of New York Department of Parks reclamation work in connection with the building of Spring Creek Park; the fill around Broad Channel and Rulers Bar Hassock for the construction of Cross-Bay Boulevard in the 1920s; and the operations concerned with the development of John F. Kennedy Airport.

The excellent harbor facilities and location in respect to canal and railroad transportation systems have contributed to the growth of the City of New York. In addition to shoreline development associated with the city's commerce as a port, the high population density has caused development in areas subject to flooding.

Despite the proximity of the City of New York to the Atlantic Ocean and its numerous bays and rivers, the climate of the city is more continental than maritime. This is because the weather conditions affecting New York usually approach the city from the west. However, the maritime influence is not totally absent. During the summer, sea breezes moderate the heat, and during the winter, coastal storms accompanied by winds from the east may bring considerable amounts of rain or snow.

The mean annual temperature for the City of New York is 52.6 degrees Fahrenheit (°F). Subfreezing temperatures occur on an average of 92 days per year; however, subzero weather may occur only two days in every three winters. During an average summer, the temperature reaches the 90s on 7 days. Temperatures of 100°F or higher have occurred approximately 7 times since 1871.

Precipitation is moderate and is distributed evenly throughout the year. The normal annual precipitation is 42.92 inches; with approximately 25 inches occurring between April and October. A prolonged dry period may be expected approximately every two or three years, usually in September or October. Rainfall occurring between June and September is usually the result of thunderstorms and is brief and relatively intense. From October through April, rainfall is generally associated with widespread storms generating day-long precipitation. The average annual snowfall is approximately 31 inches and occurs on an average of approximately 35 days between November and April (R. A. Murdoff, 1959).

The City of New York consists of three physiographically different areas. Bronx and New York Counties are an eroded southern extension of the glaciated upland area that occupies a large part of New England. The northern half of Kings and Queens Counties and all but a one-mile wide strip on the southeastern shore of Richmond County consists of terminal moraine and the hilly till-covered area north of the terminal moraine. The remainder of these three counties are made up of glacial outwash plain.

The New York Bight is the geographic designation for the portion of the continental shelf bordered by the Atlantic Coastal Plain extending from Cape May, New Jersey, northeast to Montauk, Long Island. It is characterized by beaches, numerous shallow, irregular estuaries and bays, the most prominent of which is the estuary of the Hudson River. The Hudson River has drowned valley morphology. Sediment movement and deposition have resulted in significant changes in the shelf area nearest the bight.

Long Island Sound also has drowned valley morphology. The southern slope of the ground, near Long Island, is steep and smooth, reaching depths of over 140 feet.

New York Bay is divided into Upper New York Bay and Lower New York Bay by the Narrows. The Upper Bay is bounded by the Battery on the north and Fort Hamilton-Fort Wadsworth on the south. The Lower Bay is bounded by Fort Hamilton and Sandy Hook.

Raritan Bay is part of the system of interconnected bays and channels surrounding Staten Island and the northern coast of New Jersey. This system also includes Arthur Kill, Kill Van Kull, and Newark Bay.

The Bronx River extends 23 miles from its mouth at the East River to Kensico Reservoir. The Kensico Reservoir does not release flows to the river, but serves as a water supply for the City of New York. From the reservoir, the river flows through Westchester County. Within the City of New York, the Bronx River flows south from the Yonkers corporate limits through the center of the borough for approximately 8.7 miles to its mouth at the East River. The river once served as the border between the Cities of Yonkers and Mount Vernon; however, continued relocations of the river have altered this. Within the City of New York, a series of four dams cause a drop in elevation of approximately 40 feet. The dams limit backwater effects from reaching far upstream on the Bronx River. Within the city, the river drops a total of 60 feet before flowing into the East River between Hunts Point and Claron Point. The Bronx River has a drainage area of 56.4 miles at its mouth. Exclusion of the areas draining into four water supply reservoirs reduces the drainage area to 38.3 square miles. The average width of the drainage basin is 2.5 miles. Discharge data is available from USGS gaging station No. 01376500 at Bronxville, New York.

The Hutchinson River originates in New Rochelle and flows for approximately 11 miles to Long Island Sound. The Hutchinson River is tidally controlled for its entire length. Within the study area, the river drops approximately 225 feet and has a drainage area of 5.8 square miles. Discharge data for the Hutchinson River is available from USGS gaging station No. 013015 at Pelham, New York.

The Hudson River originates in the Adirondack Mountains. The river has a drainage area of 13,400 square miles, most of which lie in the northern and eastern parts of New York and in small portions of Vermont, Massachusetts, Connecticut, and New Jersey. The lower Hudson is an estuary with tidal effects propagating 150 miles upstream to the Green Island Dam at Troy, New York, and downstream from the confluence of the Mohawk River.

The East River and the Harlem River serve as a connection between the Hudson River, the Upper Bay and Long Island Sound. The East River also serves as the boundary between southeast New York County and western Queens County, and between Bronx County and northern Queens County.

Jamaica Bay is a semi-enclosed body of water, sheltered from the Atlantic Ocean by the Rockaway Peninsula. The Rockaway Inlet is a long, narrow channel between the peninsula and Brooklyn, and is the only connection between the bay and the ocean. Many islands make Jamaica Bay into a network of channels and marshy areas.

2.3 Principal Flood Problems

The City of New York is affected by flooding from local, fluvial, and coastal flooding. Local flooding refers to flooding of inland portions of the city from short-term, high-intensity rainfall in areas with poor drainage.

Fluvial flooding is caused by rivers and streams overflowing their banks. Most of the rivers within the City of New York are tidally influenced. This means that water levels in the rivers are controlled by the tidal conditions at the mouth of the river with little or no influence from the flow in the stream. Both fluvial and tidal flooding associated with waves occur within the study area; however, tidal flooding was found to be the primary cause of damage within the city.

Coastal flooding is caused by long and short wave surges that affect the shores of the open ocean, bays and tidally influenced rivers, streams, and inlets. The movement of coastal waters is influenced by the astronomic tide and meteorological forces such as northeasters and hurricanes. Hurricanes and northeasters have historically caused flooding in and around the study area. Inundation of low-lying coastal areas in the City of New York is primarily the result of storm surges, wave setup, and wave runup, which occur during hurricanes and northeasters.

The City of New York is built in a confined coastal location, which accounts for much of its natural protection against hurricanes. The strongest winds from a storm rarely reach New York since the New Jersey coast is on one side of the city and Long Island is on the other side. However, high storm surges can propagate within the New York Bight and cause severe flooding along the coastal portions of the city. Moreover, the cuplike topography of the area accounts for most of the dynamic effects, including resurgence, which cause the waters to oscillate to flood levels well after the storm has left the area.

Sections of Queens, Brooklyn, and Staten Island are exposed to direct ocean surges and waves. Coney Island and the Rockaway Peninsula are particularly vulnerable to wave damage. On Rockaway Peninsula and Jamaica Bay, the shoreline configuration has changed considerably over the past 50 years due to dredging and filling. These changes affect wave propagation, particularly in areas such as Rockaway Point at Rockaway Inlet, where the configuration of the point controls the direction of the incoming waves. Surge waves can also propagate through Long Island Sound. Consequently, a surge wave along the East River can propagate in the New York Bight, into New York Bay through the Hudson River and enter the East River from the south.

Jamaica Bay is affected by astronomical tides, storm surges from the Atlantic Ocean off New York Bay, wind-generated wave setups within the bay, and rainfall runoff from other areas (American Society of Engineering, 1964). The outer shoreline of the Rockaway Peninsula is subject to tidal fluctuations from the Atlantic Ocean. The Rockaway Peninsula is a surge barrier to Jamaica Bay; however, a storm surge can almost entirely inundate the peninsula.

The most severe flooding conditions result from the overtopping of the peninsula. The low-lying areas of Brooklyn and Queens including Kennedy Airport are directly affected by flooding from Jamaica Bay.

The northern portion of Queens and the east Bronx are directly affected by surges originating in Long Island Sound. The east shore of City Island has a history of severe damage. In 1969, it was estimated that a recurrence of the 1938 hurricane, the storm of record, would produce $23 million damage of City Island alone.

Detailed descriptions of coastal flood damage in and around the City of New York caused by the November 1950, November 1953, September 1960, and March 1962 storms are presented in Study Overview (Camp, Dresser and McKee, 1983).

The storm of November 1950 caused millions of dollars worth of damage and required evacuation of many parts of New York. Damage as a result of the flood occurred in parts of Queens, Jamaica Bay, Brooklyn, Rockaway Point, and Staten Island. Tides inundated portions of Staten Island for up to one mile inland.

Damages on Staten Island during the storm of November 1953 totaled almost $1,000,000. During this flood, Rockaway Point beaches were severely eroded and the protective dunes were leveled. Homes along the ocean and bay were inundated by one to two feet of water. Wave crest heights ranged to an estimated 25 feet along the Atlantic Ocean.

The tide of record (8.6 feet at Fort Hamilton, Brooklyn, New York) resulted from the hurricane of September 1960. The City of New York experienced damage estimated at close to $20,000,000.

As a result of the March 1962 storm, the City of New York experienced damages totaling approximately $17,000,000. Portions of Coney Island and Rockaway Beach were inundated by one to two feet of water.

2.4 Flood Protection Measures

Numerous flood protection measures have been developed in the City of New York. Many portions of the city are subjected to the direct influence of the ocean and have had bulkheads constructed for the purpose of beach stabilization. Riprap and seawalls have been constructed to dissipate waves caused by tidal action. Much construction has been elevated or protected to prevent extensive flood damage. In order to comply with requirements allowing citizens to be eligible for the Flood Insurance Program, the City of New York calls for all new construction to be protected to a specified elevation. A summary of flood protection measures for Staten Island, the Rockaway Peninsula, and Jamaica Bay is presented in Study Overview (Camp, Dresser and McKee, 1983).

The City of New York has an intricate navigational system. While the purpose of the system is not to provide flood protection, the existence of well-maintained channels assures a relatively unrestricted flow of water throughout the area.

The principal deep-water channels of the port of New York include: Ambrose Channel, from the Atlantic Ocean into Lower New York Bay; Anchorage Channel, in Upper New York Bay; and the Hudson River Channel, up to 59th Street. These channels have a depth of 45 feet and a width of 2,000 feet. Buttermilk, Bay Ridge, and Red Hook Channels, the East River to the Brooklyn Navy Yard, and tributary channels all have depths of 40 feet. Kill Van Kull and Arthur Kill Channels, known as the New York and New Jersey Channels, respectively, have a separate entrance to the ocean by way of Bayside Channel and have depths of 35 feet. A recently authorized modification provides a new entrance channel replacing the eastern portion of the Bayside-Gedney Channel. The East River has been improved to a point 35 feet beyond the Navy Yard. Secondary channels such as Gowanus Creek, Newtown Creek, Coney Island Channel, Rockaway Inlet, Jamaica Bay, and the Harlem River have depths ranging from 15 to 30 feet.

Federal construction and maintenance costs now total more than $200 million since the first dredging and removal of rock obstructions at Hells Gate in the East River was undertaken by the U.S. Army Corps of Engineers (USACE) in 1853. The average annual commerce in the Port of New York between 1966 and 1975 was over 180 million tons. Commerce including waste material during 1975 was more than 177 million tons. While the port has naturally deep water harbors and channels, extensive improvements have been made over the last 150 years. Some of the current active projects are listed below and detailed descriptions can be found in Water Resources Development in New York (USACE, 1977).

Bay Bridge and Red Hook Channels
Bronx River - Channel Improvement
Buttermilk Channel
Coney Island Channel
Coney Island Creek - Channel Improvement
East Chester Creek - Channel Improvement
East Chester Bay - Channel Improvement
East River - Channel Improvement
East Rockaway Inlet - Channel Improvement
Flushing Bay and Creek - Channel and Anchorage Area Improvement
Gowanus Creek Channel
Great Kills Harbor
Harlem River - Channel Improvements
Hudson River Channel, New York and New Jersey
Jamaica Bay - Channel Improvement
Newtown Creek - Channel Improvement
New York and New Jersey Channels
New York Harbor - Entrance Channels and Anchorage Areas
Sheepshead Bay - Channel Improvement
Wallabout Channel - Channel Improvement
Westchester Creek - Channel Improvement

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

For the 1983 FIS, the City of New York separately examined the impact of fluvial flooding, coastal flooding caused by hurricane surges, and coastal flooding caused by northeasters. Since the causes of flooding are independent, the separate results were combined in a probabilistic sense. A wave height analysis was also performed to account for the inclusion of short-period, wave-induced waves. The extensive hydrologic and hydraulic analyses necessary to accomplish this study have been documented in a series of reports prepared for the New York State Department of Environmental Conservation (NYSDEC) (Camp, Dresser and McKee, 1983, 1979, 1982, April 1981, 1980, December 1981, November 1981, Total Stillwater Elevations; November 1981, Wave Crest Analysis).

3.1 Riverine Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

Riverine flooding affects only a small portion of flood-prone areas in the City of New York, primarily in the Boroughs of the Bronx and Staten Island. Flooding from the Bronx and Hutchinson Rivers may potentially cause overbank flooding in the northern portion of the city.

From the FIS for Mount Vernon, Westchester County, New York, it was determined that flooding along portions of the Hutchinson River downstream of East Sanford Boulevard was completely tidally controlled; therefore, no fluvial analysis was performed (FEMA, 1978). The stage-frequency analysis for the Hutchinson River in the Bronx is, therefore, performed as part of the coastal analysis in the original study.

For the original study, a log-Pearson Type III distribution of the annual peak flows was used to generate discharge-frequency relationships recorded at the USGS gage No. 01376500 at Bronxville, New York (36 years of record) for the Bronx River (Water Resources Council, 1977; U.S. Department of the Interior, 1979). Discharge-frequency estimates were made for other points along the Bronx River by adjusting the discharge-frequency curve at the gaging station according to the ratios between corresponding drainage areas, main channel slopes, surface storage indexes, and indexes of manmade impervious cover. The procedure is documented in a report prepared for the NYSDEC (Camp, Dresser and McKee, April 1981). A similar procedure was used to study New Jersey by the State of New Jersey Department of Environmental Protection (Stankowski, 1974).

The studied streams within the Borough of Staten Island are small and ungaged. For this revision, the USACE HEC-1 Flood Hydrograph computer program was used to establish peak discharge and peak elevation-frequency relationships for all streams except Wood Duck Pond and Eibs Pond, where a stage elevation relationship was derived and analyzed.

A summary of the drainage area-peak discharge relationships for a portion of the streams studied by detailed methods is shown in Table 3, "Summary of Discharges."

TABLE 3 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ARBUTUS CREEK					
Confluence with Arbutus Lake	0.71	205	330	404	575
Upstream of Hylan Boulevard	0.59	293	414	484	650
Upstream of Arbutus Avenue	0.42	211	297	347	450
Upstream of Louise Street	0.37	187	263	307	410
At confluence with Jansen Tributary	0.30	151	212	248	320
Upstream of Amboy Road	0.23	117	165	193	260
BLUE HERON MAIN BRANCH					
Outflow from Lipsett Pond	0.50	193	239	345	440
Upstream of Hylan Boulevard	0.47	208	303	342	430
Upstream of confluence with Blue Heron Main Tributary	0.22	112	134	193	245
Upstream of Eylandt Street	0.17	92	131	155	195
Upstream of Tallman Street	0.10	50	72	85	110
BLUE HERON TRIBUTARY					
Upstream confluence with Blue Heron Main Branch	0.13	75	109	128	170
Upstream Barclay Avenue	0.08	47	70	82	110
BRONX RIVER					
At confluence with East River	38.3	2,312	3,486	4,097	5,798
At East Gun Hill Road	34.4	2,175	3,286	3,866	5,495
At East 238th Street (corporate limits)	31.4	2,065	3,125	3,680	5,250
At USGS gage 01302000 at Bronxville	26.5	1,875	2,847	3,358	4,823
BUTLER MANOR					
Mouth to Raritan Bay	0.18	305	414	276	600
Approximately 1,000 feet upstream of Raritan Bay	0.18	172	228	257	315
Upstream of Richard Avenue	0.06	67	82	89	105
Upstream of Hylan Boulevard	0.05	50	60	62	70
Upstream of Hylan Boulevard	0.05	64	89	104	130

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
COLON TRIBUTARY					
Confluence with Sweet Brook	0.36	108	151	177	225
Approximately 1,530 feet Upstream of D Street	0.01	126	166	192	248
DENISE TRIBUTARY					
Confluence with Arbutus Creek	0.13	65	92	108	150
ELTINGVILLE TRIBUTARY					
Confluence with Sweet Brook	1.17	339	479	560	710
FORESTHILL ROAD BROOK					
Approximately 756 feet upstream of Foresthill Road	*	263	387	443	565
At the confluence with Richmond Creek	*	126	172	199	260
JANSEN TRIBUTARY					
Confluence with Arbutus Creek	0.05	25	35	41	57
LEMON CREEK					
Mouth to Princes Bay	2.09	490	708	849	1,120
Upstream of Bayview Avenue	1.67	390	572	689	920
Upstream of S.I.R.T.	1.23	290	438	529	730
Upstream of Maguire Avenue	0.77	147	246	301	440
At Richmond Parkway	0.73	139	234	285	425
Upstream of Richmond Parkway/confluence with Sandy Bridge	0.50	100	171	209	315
Upstream of Detention Basin Outlet near Helene Court	0.38	86	153	189	285
Outlet from Prodzio Pond	0.16	37	63	78	115
Upstream of Rossville Avenue	0.09	27	40	47	62
MILL CREEK					
Upstream of Page Avenue – downstream limit of study	1.30	1,012	1,411	1,653	2,100
Upstream of lower S.I.R.T. crossing	0.61	533	742	863	1,080

*Data not available

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
MILL CREEK (continued)					
Upstream of Upper S.I.R.T. crossing	0.59	516	718	835	1,050
Upstream of Boscombe Avenue (gage)	0.47	408	569	661	840
Upstream of Richmond Parkway	0.39	311	434	506	620
Upstream of West Shore Expressway	0.24	159	223	260	335
Upstream of Vereans Road West	0.12	69	97	114	150
MILL CREEK TRIBUTARY 1					
Confluence with Mill Creek	0.16	153	213	247	320
MILL CREEK TRIBUTARY 2					
Confluence with Mill Creek	0.42	368	513	597	760
MILL CREEK TRIBUTARY 3 (TO TRIBUTARY 2)					
Confluence with Mill Creek Tributary 2	0.15	164	228	265	340
RICHMOND CREEK					
Upstream of Arthur Kill Road	1.90	780	1,010	1,170	1,400
Upstream of Eleanor Street	1.00	335	440	515	620
Upstream of Rockland Avenue	0.50	150	200	230	280
SANDY BROOK					
At confluence with Lemon Creek	0.22	48	70	83	115
Upstream of Bloomingdale Road	0.13	33	48	57	78
SWEET BROOK					
Upstream of Arthur Kill Avenue	2.92	793	1,142	1,388	1,850
Upstream of Abingdon Avenue	2.23	602	875	1,070	1,500
Upstream of Ridgewood Road	2.09	567	826	1,011	1,380
Upstream of Genesee Avenue/ Richmond Avenue	2.06	558	814	997	1,360
Upstream of confluence with Eltingville Tributary	0.84	219	337	424	600
Upstream of Grantwood Avenue	0.65	178	278	352	640
Upstream of Arden Avenue	0.52	154	243	310	440
Upstream of Detroit Avenue	0.46	151	222	296	400

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
SWEET BROOK (continued)					
Upstream of Ionia Avenue	0.43	139	208	278	380
Upstream of Richmond Parkway	0.40	124	191	256	340
Upstream of Annadale Wedge Pond	0.30	88	145	194	280
Upstream of Sheldon Avenue	0.30	132	185	217	300
WOLFES POND					
Mouth at outlet to Raritan Bay (downstream study limit)	0.91	227	290	380	620
Downstream Wolfe's Pond	0.89	225	287	377	610
Upstream Wolfe's Pond	0.89	238	300	411	680
Downstream Hylan Boulevard	0.71	190	240	344	530

The stillwater elevations have been determined for the 10-, 50-, 100-, and 500-year floods for the flooding sources studied by detailed methods and are summarized in Table 4, "Summary of Stillwater Elevations."

TABLE 4 – SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE	ELEVATION (feet NGVD*) 100-YEAR
Amboy Road Wetland	50.27
Cleveland Avenue Wetland	57.98
Eibs Pond	87.40
Hillside Avenue Wetland	55.53
Jacks Pond	52.32
Stump Pond	271.20
Wood Duck Pond	53.87

*National Geodetic Vertical Datum of 1929

3.2 Riverine Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Below-water sections were obtained by field measurement. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Along certain portions of Sweet Brook and Lemon Creek, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles and floodway data tables.

Channel roughness factors (Manning's "n") used in the hydraulic computations for the streams studied by detailed methods were chosen by engineering judgment and based on field observations of the streams and floodplain areas (Barnes, 1967). For streams studied by detailed methods, the channel "n" value used was 0.015-0.035 and the overbank "n" values ranged from 0.04 to 0.12. An "n" value of 0.015 was used for concrete structures and 0.024 was used for corrugated metal pipes. A weighted average "n" value was used for bridges with steel decks, concrete abutments, and earthen bottoms. Non-effective flow areas were disregarded by using extremely high "n" values. The acceptability of all assumed hydraulic factors, cross sections, and hydraulic structure data was checked by calibrating computed flood profiles to known historic flood profiles.

For the May 21, 2001, revision, for streams studied by detailed methods, water-surface elevations of floods of selected recurrence intervals were computed through the use of the HEC-2 step-backwater computer program (USACE, 1990).

The course of several streams in the Borough of Staten Island has been enclosed in storm sewers. In some cases, these storm sewers were found to be unable to contain the 100-year flood discharges. The capacity of these storm sewers was estimated using standard pipe flow methods and was subtracted from the estimated 100-year flood discharge at the entrance. Based on the street network and the line of greatest slope, a profile baseline was estimated for the excess discharges and was incorporated into the HEC-2 program.

For this revision, for streams studied by detailed methods, water-surface elevations of floods of selected recurrence intervals were computed through the use of HEC-RAS. Starting water-surface elevations for Blue Heron Main, Blue Heron Tributary, Butler Manor, D Street Brook, Denise Tributary, Foresthill Tributary, Jensen Tributary, Lemon Creek, Richmond Creek and Sandy Creek were obtained by utilizing normal depth. Starting water-surface elevations for Arbutus Creek were obtained by utilizing critical depth. Starting water-surface elevations for the remaining revised streams were obtained from known water surface elevations as per studies conducted by the NYC DEP.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the flood profiles (Exhibit 1). For stream segments for which a floodway is computed

(Section 4.2), selected cross-section locations are also shown on the revised FIRM (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Coastal Analyses

Users of the FIRM should be aware that coastal flood elevations are provided in the Summary of Stillwater Elevations table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Coastal stillwater analysis was performed for the Harlem, Hudson, Hutchinson, and East Rivers, Arthur and Bronx Kills and Kill Van Kull, the Atlantic Ocean, Raritan Bay, New York Bay, Jamaica Bay, Long Island Sound, Little Neck Bay, and all the bays and inlets within these areas.

The City of New York and the New York Bight area are affected equally by hurricanes and northeasters. The extent of coastal flooding due to hurricanes and northeasters is determined by three factors: 1) the nature of the storm with respect to intensity, duration, and path; 2) astronomic tide conditions at the time the storm-surge wave reaches the shore; and 3) the physical geometry and bathymetry of a particular area, which affects the timing and passage of the surge wave.

For the coastal flooding sources studied by detailed methods, surge depths were determined independently of the astronomic tide by the application of a synthetic storm to generate surges. The propagation of surges through the entire waterway system is simulated by use of mathematical models which dissipate the surge waves in a manner consistent with the physical and hydraulic properties of the waterway system and determine elevations at any selected location along the coast. An off-shore surge generation model was used to generate surges from hurricanes over the continental shelf. An embedded link-node network model was used to propagate the surge inland through the New York Bight and into the harbor and bays. The second model enables a finer spatial resolution for computing storm surges at all coastal locations in the city. A different set of models was developed which included a northeaster wind field algorithm to properly simulate the surge producing mechanisms of northeasters.

The two models were calibrated to astronomic tidal conditions to establish the hydrodynamic characteristics of the study area. The models were then calibrated to Hurricane Carol (1954) and verified against Hurricane Edna (1954) and Donna (1960), and the hurricane of 1938. The northeaster wind algorithms were calibrated and verified using 13 historical northeasters.

Observed historical data were used to develop discrete distributions of storm surge events that have the potential to occur. Total stillwater elevations were determined by combining each stillwater elevation with the complete range of local tidal conditions also based on historical data and accounting for non-linearities in the combination. Thus, a simulation of 252 hurricanes and 42 northeasters at 50 phases of 5 tides resulted in 73,500 simulated flooding events for each point of interest in the study area.

The Joint Probability Method (JPM) was used to determine the stillwater elevations at specific recurrence intervals (Myers, 1970). Application of the JPM consisted of assigning annual probabilities of occurrence to each synthetic storm based on the probabilities of its characteristics. The resulting peak tide levels from each synthetic storm were summed in half-foot increments from 0 to 20 feet at each selected point. Cumulative annual exceedence probabilities at each point were obtained by summing the annual occurrence probabilities from high to low elevations. Finally, hurricane and northeaster frequency curves were combined by summing annual exceedence probabilities. The resulting coastal stillwater elevations for the 10-, 50-, 100-, and 500-year recurrence intervals at selected locations in the study area are presented in Table 3, "Summary of Stillwater Elevations." A discussion of the statistical analysis of historical hurricanes, the modeling of hurricane surges, simulation of northeasters, and determination of total stillwater elevations is documented in a series of reports prepared for the NYSDEC (Camp, Dresser and McKee, 1982, 1980, November 1981, December 1981).

3.4 Wave Height Analyses

The wave height analysis was carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline of the Atlantic Ocean, Raritan Bay, New York Bay, Jamaica Bay, Long Island Sound, Little Neck Bay, and the East River.

The destructiveness of high stillwater elevations due to coastal flooding may be increased by wind-induced waves which contribute to increased water levels and whose size and velocity may damage structures directly. The height of a wave is dependent upon wind speed and its duration, depth of water, and length of fetch. The wave crest elevation is the sum of the stillwater elevation and the portion of the wave height above the stillwater elevation.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE, 1975). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures. The V-zone limits are depicted at locations where there is no longer sufficient depth to support a 3-foot breaking wave. However, when the beach profile is eroded during the 100-year flood event with severe wave conditions, the V-zone limit is moved inland to locations where a 3-foot water depth could be supported by the eroded profile. The V-zone elevations are interpolated between transects to give their areal extent.

The wave crest analysis was conducted according to the methodology developed by the National Academy of Sciences (NAS) and adopted by FEMA as a standard component of coastal FISs (NAS, 1977). The required computations for the analysis were performed using the WHAFIS computer program (FEMA, January 1981). Wave heights were computed along transects which were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

A total of 125 transects were coded and wave crest elevations and flood hazard factors were computed using the WHAFIS program (FEMA, January 1981). Accurate topography, land-use, and land cover data are required for the coastal analysis. Maps of the study area at a scale of 1:4,800 with a contour interval of 2 feet and aerial photographs at a scale of 1:12,000 were used for the topographic data (NYSDEC, 1979; Keystone, 1979). The land-use and land cover data were obtained through field surveys.

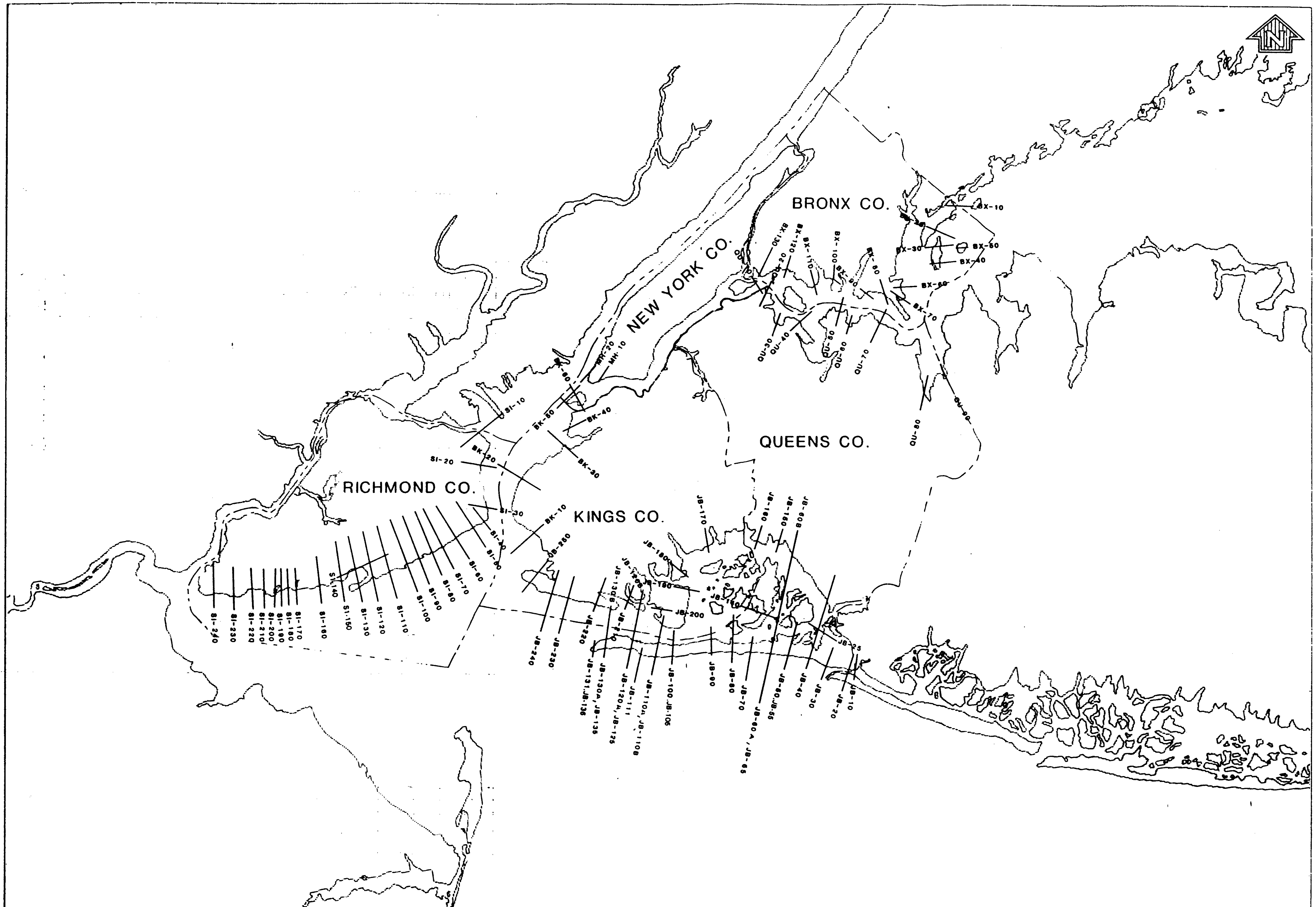
The number and location of transects were chosen to be representative of uniform lengths of the coastline with little variation of the 100-year stillwater levels. The transects are named for the specific region they represent and are labeled as follows:

For transects located on enclosed embayments, the longest possible overwater fetch length that could affect the area was used to compute the wave heights. Figure 1 illustrates the location of the transects for the community and Table 4, "Transect Descriptions" provides a physical description of the area along the shoreline represented by each transect. In areas of uncertainty, additional intermediate transects were coded and analyzed.

BX - Bronx
SI - Staten Island
BK - Brooklyn
JB - Jamaica Bay
MH - Manhattan
QU - Queens

In all cases, transects were oriented to represent the worst possible fetch conditions. For example, all transects on Rockaway Peninsula were computed with the wind blowing from the ocean to represent the worst conditions for the southern shores, and with the wind blowing across Jamaica Bay to represent the worst conditions for the northern shoreline.

Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Each transect extends far enough inland from the coast to cover all open areas (bays, rivers, and open marsh) and extends to a point high enough to match the 100-year flood elevation. Wave heights were calculated to the nearest 0.1 foot, and wave crest elevations were determined at whole-foot increments along the transects. The calculations were carried inland along the transect until the wave crest elevation was permanently less than 0.5 foot above the stillwater elevation or until the coastal flooding met another flooding source (i.e., riverine) with an equal water-surface elevation. The results of the calculations are considered accurate until local topography, vegetation, and cultural development within the community undergo any major changes.



APPROXIMATE SCALE

6 0 6 12 18 MILES

TRANSECT LOCATION MAP

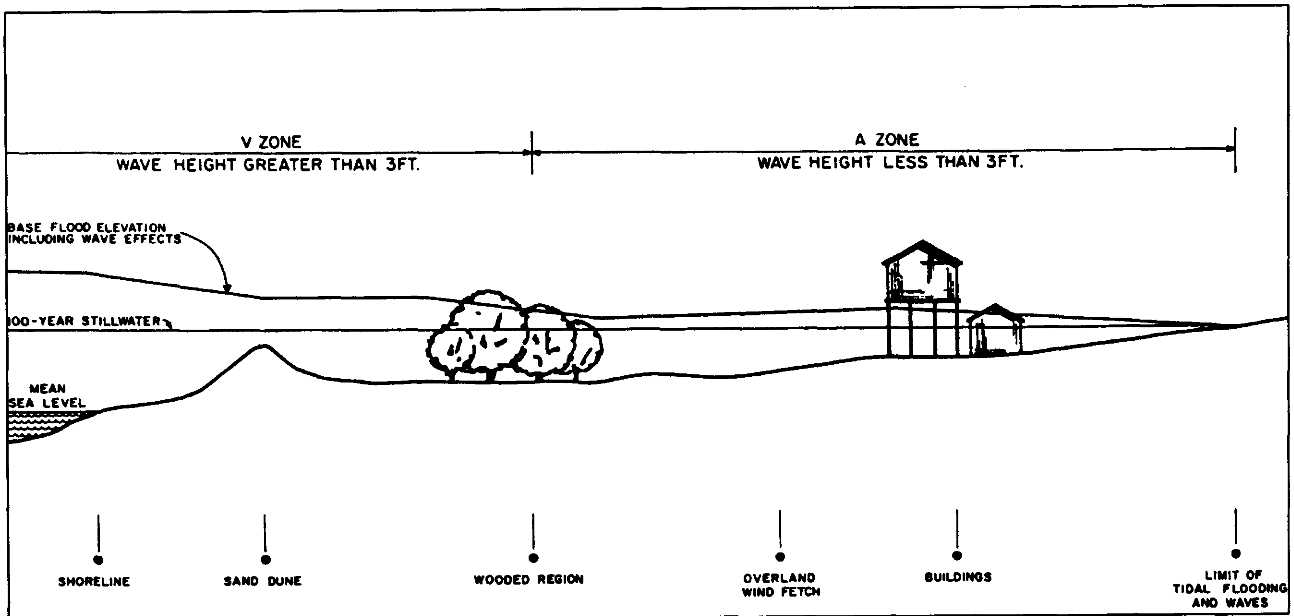
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

(BRONX, QUEENS, NEW YORK, KINGS AND RICHMOND COS.)

FIGURE 1

Figure 2 represents a sample transect which illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the A/V zone boundary.



TRANSECT SCHEMATIC Figure 2

For each transect, the program produces a maximum wave height elevation which defines the inland extent of flooding. Between transects, height elevations are interpolated to give the areal extent of flooding.

A complete discussion of the wave height analysis included in the original study is presented in a report prepared for the NYSDEC (Camp, Dresser and McKee, November 1981).

The stillwater elevations and maximum wave crest elevations of the selected recurrence intervals are shown in Table 5, "Summary of Coastal Stillwater Elevations."

TABLE 5 - SUMMARY OF COASTAL STILLWATER ELEVATIONS

	ELEVATION (feet NGVD*)			
FLOODING SOURCE AND LOCATION	10-YEAR	50-YEAR	100-YEAR	500-YEAR
ARTHUR KILL				
At confluence with Raritan Bay	7.6	9.3	10.1[1]	12.2
At Outerbridge crossing	7.4	9.1	9.8[1]	11.7
At Bloomingdale Road (extended)	7.1	8.7	9.6[1]	11.3
At Victory Boulevard (extended)	6.5	8.0	8.6[1]	10.4
At Richmond Terrace (extended)	6.5	7.8	8.3[1]	10.0

*National Geodetic Vertical Datum of 1929
[1]Stillwater Elevation
[2]Stillwater Elevation/Maximum Wave Crest Elevation

TABLE 5 - SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD*) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ATLANTIC OCEAN				
At Rockaway Beach shoreline	7.4	9.1	9.8/15[2]	12.2
At Rockaway Inlet Lower Bay	6.6	8.1	8.9/13[2]	11.0
BRONX KILL				
East of Triborough Bridge approach	9.2	11.3	12.5[1]	15.4
At confluence with Harlem River	8.5	10.4	11.3[1]	14.1
BRONX RIVER				
At mouth	9.8	12.1	13.3[1]	16.7
EAST RIVER				
At confluence with Upper Bay	7.5	9.0	9.7[1]	11.9
At Brooklyn Bridge	7.3	8.9	9.6[1]	11.8
At Queensboro Bridge	7.2	8.8	9.6[1]	12.0
At Roosevelt Island	8.1	9.1	10.8[1]	13.4
East of New York, New Haven, and Hartford Railroad Bridge	8.5	10.4	11.4[1]	14.1
At Rikers Island	9.2	11.3	12.5/17[2]	15.6
At Bronx Whitestone Bridge	9.7	12.0	13.2/17[2]	16.2
At Throgs Neck Bridge	9.8	12.2	13.5/17[2]	16.5
HARLEM RIVER				
At confluence with East River	9.6	11.8	13.0[1]	16.0
At confluence with Bronx Kill	8.8	10.4	11.3[1]	14.1
North of Macombs Dam Bridge	6.9	9.2	10.0[1]	12.5
At University Heights Bridge	6.8	8.7	9.4[1]	11.7
At confluence with Hudson River	7.1	8.6	9.4[1]	11.7
HUDSON RIVER				
At confluence with Upper Bay	7.4	9.0	9.7[1]	11.9
At George Washington Bridge	7.3	8.8	9.6[1]	11.7
At corporate limits	6.9	8.4	9.2[1]	11.6
HUTCHINSON RIVER				
At mouth	9.9	12.4	13.7/16[2]	16.8
At corporate limits	10.1	12.7	14.0/16[2]	17.4
JAMAICA BAY	6.0	7.2	7.9/11[2]	9.7

*National Geodetic Vertical Datum of 1929
[1]Stillwater Elevation
[2]Stillwater Elevation/Maximum Wave Crest Elevation

TABLE 5 - SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD*) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
KILL VAN KULL				
At confluence with Newark Bay	6.4	7.6	8.3[1]	9.5
At confluence with Upper Bay	6.9	8.5	9.0[1]	10.9
LONG ISLAND SOUND				
At confluence of East River	9.9	12.4	13.7/21[2]	16.7
At northern corporate limits	9.7	12.2	13.6/21[2]	16.5
At Little Neck Bay	10.0	12.5	13.8/21[2]	16.7
At Basin Park	9.8	12.0	12.9/15[2]	14.9
LOWER BAY				
South of Narrows Bridge	7.4	9.0	9.7/15[2]	11.9
At Gravesend Bay	7.4	9.0	9.7/15[2]	11.9
NEWARK BAY	6.4	7.7	8.2[1]	9.5
RARITAN BAY				
From Great Kills Park to Lower Bay	7.5	9.1	9.9/15[2]	12.0
From Great Kills Park to Arthur Kill	7.7	9.4	10.2/16[2]	12.3
UPPER BAY				
North of Narrows Bridge	7.4	8.9	9.7/14[2]	11.8
At Governors Island	7.5	9.0	9.8/14[2]	11.8

*National Geodetic Vertical Datum of 1929
[1]Stillwater Elevation
[2]Stillwater Elevation/Maximum Wave Crest Elevation

A physical description of the area along shoreline represented by each transect is shown in Table 6, "Transect Descriptions."

TABLE 6 - TRANSECT DESCRIPTIONS

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. BX-10	In Long Island Sound from northern corporate limits to southern end of Twin Islands including eastern shore of Pelham Bay Park and Hunters Island	13.6	21
No. BX-20	From southern tip of Twin Islands to 100 feet south of Terrace Street on City Island	13.6	21
No. BX-30	From 100 feet south of Terrace Street to Fordham Street, extended	13.6	21
No. BX-40	From Fordham Street, extended, to southern end of City Island	13.8	20
No. BX-50	Entire shoreline of Hart Island in Long Island Sound	13.6	21
No. BX-60	From southern end of City Island to Throgs Necks Bridge at Locust Point including shoreline of Eastchester Bay and the Hutchinson River	13.7	21
No. BX-70	From Throgs Neck Bridge at Locust Point to Throgs Neck Bridge at Throgs Point	13.7	21
No. BX-80	From Throgs Neck Bridge at Throgs Point to Robinson Avenue, extended	13.4	18
No. BX-90	From Robinson Avenue, extended, to Westchester Creek	13.3	18
No. BX-100	From Randall Avenue, extended, along Westchester Creek to Clason Point including Pugsley's Creek	13.2	18

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Elevation (feet NGVD 29) Maximum 100-Year Wave Crest
No. BX-110	From Clason Point to Manida Street, extended	13.0	18
No. BX-120	From Manida Street, extended, to East 149th Street	12.6	16
No. BX-130	From East 149th Street to county boundary at mouth of Bronx Kill	12.5	16
No. SI-10	Northeast shoreline of Staten Island from Westervelt Avenue, extended, to Hyatt Street, extended	9.7	14
No. SI-20	From Hyatt Street, extended, to Clifton Avenue, extended	9.7	14
No. SI-30	From Clifton Street, extended, to approximately 1,500 feet south of Verranzano Narrows Bridge	9.7	14
No. SI-40	From approximately 1,500 feet south of Verranzano Narrows Bridge to Lily Pond Avenue, extended	9.7	14
No. SI-50	From Lily Pond Avenue, extended, to Sand Lane, extended	9.7	14
No. SI-60	From Sand Lane, extended, to Quintard Street, extended	9.7	14
No. SI-70	From Quintard Street, extended, to Seaview Avenue, extended, and entire shorelines of Hoffman and Swinburn Islands	9.8	14
No. SI-80	From Seaview Avenue, extended, to 650 feet southwest of Greeley Street, extended	9.8	14
No. SI-90	From 650 feet southwest of Greely Street, extended, to New Dorp Lane, extended	9.8	14

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. SI-100	From New Dorp lane, extended, to Tysens Lane	9.8	14
No. SI-110	From Tysens Lane to Kelvin Avenue, extended	9.9	14
No. SI-120	From Kelvin Avenue, extended, to approximately 1,550 feet southwest along shoreline	10.0	14
No. SI-130	From approximately 1,550 feet southwest along the shoreline from Kelvin Avenue, extended, to entire shoreline of Great Kills Park peninsula, and from northeast shoreline of Great Kills inlet to Wiman Avenue, extended	10.0	14
No. SI-140	Entire northeast shoreline of Great Kills inlet	10.0	14
No. SI-150	From Wiman Avenue, extended, to Oceanic Avenue, extended	10.1	14
No. SI-160	From Oceanic Avenue, extended, to Arden Avenue, extended	10.1	14
No. SI-170	From Arden Avenue, extended, to Petersburg Avenue, extended	10.1	14
No. SI-180	From Petersburg Avenue, extended, to Arbutus Lake inlet	10.1	14
No. SI-190	Entire shoreline of Arbutus Lake to 400 feet west along coastline from Arbutus Lake inlet	10.1	14
No. SI-200	From 400 feet west along coastline from Arbutus lake inlet to Purdy Place, extended, including Wolfe's Pond shoreline	10.1	14
No. SI-210	From Purdy Place, extended, to Woodvale Avenue, extended	10.1	14

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. SI-220	From Woodvale Avenue, extended, to 2,400 feet southwest of Sharrott Avenue, extended	10.1	14
No. SI-230	From 2,400 feet southwest of Sharrott Avenue, extended, to Bedell Avenue, extended	10.1	14
No. SI-240	From Bedell Avenue, extended, to the mouth of Arthur Kill	10.1	14
No. BK-10	In Gravesend Bay, from Beach 49th Street extended, to Verranzano Narrows Bridge	9.7	15
No. BK-20	From Verranzano Narrows Bridge to 64th Street, extended	9.7	13
No. BK-30	From 64th Street, extended, to Henry Street Basin on Upper Bay	9.8	14
No. BK-40	From Henry Street Basin to Wolcott Street on Upper Bay	9.8	14
No. BK-50	Southern tip of Governors Island	9.7	14
No. BK-60	From Wolcott Street to Wall Street, extended, and entire shoreline of Governors island except the southern tip	9.7	14
No. JB-10	From southeast Queens County boundary to Beach 9th Street on East Rockaway Beach	9.7	12
No. JB-20	From Beach 9th Street to Beach 17th Street, extended, on East Rockaway Beach	9.7	15
No. JB-25	From Mott Basin to Norton Basin	7.9	10
No. JB-30	From Beach 17th Street, extended, to Beach 36th Street, extended	9.7	15

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. JB-40	From Beach 36th Street to Beach 61st Street, extended	9.7	15
No. JB-50	From Beach 61st Street, extended, to 100 feet west of Beach 73rd Street	9.7	15
No. JB-55	From the mouth of Norton Basin to 65th Street, extended	7.9	11
No. JB-60A	From Beach 73rd Street, extended, to 350 feet west of Beach 84th Street, extended	9.7	15
No. JB-60B	From Head of Bay Basin to 1,200 feet east of New York Transit System Bridge in Jamaica Bay	7.9	11
No. JB-65	From 65th Street, extended, to New York City Transit System Bridge	7.9	11
No. JB-70	From 350 feet west of Beach 84th Street, extended, to Beach 101st Street	9.8	15
No. JB-75	From New York City Transit System Bridge to Beach 116th Street, extended	7.9	11
No. JB-80	From Beach 101st Street to Beach 116th Street, extended	9.8	15
No. JB-90	From Beach 116th Street, extended, to 150 feet west of 149th Street, extended	9.8	15
No. JB-95	From Beach 116th Street, extended, to Beach 145th Street, extended	7.8	11
No. JB-100	From Beach 140th Street, extended, to 150 feet west of 149th Street, extended	9.8	15
No. JB-105	From Beach 145th Street, extended, to 1,450 feet east of Marine Parkway Bridge	7.8	11

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Elevation (feet NGVD 29) Maximum 100-Year Wave Crest
No. JB-110A	From 150 feet west of 149th Street, extended, to 1,750 feet west of Beach 169th Street, extended	9.8	15
No. JB-110B	From 2,500 feet east of Marine Parkway Bridge to 1,600 feet west of Marine Parkway Bridge	8.9	11
No. JB-111	From 1,750 feet west of Beach 169th Street, extended, to 1,300 feet east of Beach 201st Street, extended south	9.8	15
No. JB-116	From 1,450 feet east of Marine Parkway Bridge to 200 feet west of Beach 201st Street, extended north	8.9	11
No. JB-120A	From 1,300 feet east of Beach 201st Street, extended south, to 1,800 feet east of Beach 219th Street, extended	9.9	15
No. JB-120B	From mouth of Shell Bank Creek to 3,500 feet east of Brigham Street	8.9	11
No. JB-125	From 200 feet west of Beach 201st Street, extended north, to 1,000 feet west of Beach 216th Street, extended	8.7	10
No. JB-130A	From 1,800 feet east of Beach 219th Street, extended, to Beach 222nd Street, extended	9.9	15
No. JB-130B	From Oriental Boulevard, extended, to Ocean Avenue, extended	9.9	11
No. JB-131	From Beach 222nd Street, extended south, to Rockaway Point	9.9	15
No. JB-135	From 1,000 feet west of Beach 216th Street, extended, to 450 feet west of Beach 222nd Street, extended north	9.4	11
No. JB-136	From 450 feet west of Beach 222nd Street, extended north, to Rockaway Point	9.4	13

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. JB-140	Entire shoreline of Rulers Bar Hassack and Ruffle Bar in Jamaica Bay	9.9	10
No. JB-150	From 1,200 feet east of New York City Transit System Bridge to Shell Bank Basin	7.9	11
No. JB-160	From Shell Bank Basin to Spring Creek Basin	7.9	11
No. JB-170	From Spring Creek Basin to Paerdegat Basin, and entire shoreline of Canarsie Pol	7.9	11
No. JB-180	From Paerdegat Basin to Mill Basin	7.9	11
No. JB-190	From Mill Basin to 2,500 feet east of Marine Parkway Bridge	7.8	11
No. JB-200	From 1,600 feet west of Marine Parkway Bridge to mouth of Shell Bank Creek	8.7	13
No. JB-210	From 3,500 feet east of Brigham Street to Oriental Boulevard, extended	9.0	13
No. JB-220	From Ocean Avenue, extended, to Coney Island Avenue, extended	9.5	15
No. JB-230	From Coney island Avenue, extended, to West 12th Street, extended	9.5	15
No. JB-240	From West 12th Street, extended, to West 24th Street, extended	9.6	15
No. JB-250	From West 24th Street, extended, to Beach 49th Street at Norton Point	9.6	15
No. MH-10	From Brooklyn Bridge on the East River to Wall Street, extended	9.6	15
No. MH-20	From Wall Street, extended, to Battery Place, extended	9.7	14

TABLE 6 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (feet NGVD 29) 100-Year Stillwater	Maximum 100-Year Wave Crest
No. QU-10	From mouth of Bronx Kill at county boundary to 20th Street along East River	12.5	17
No. QU-20	From 20th Street along East River to 35th Street, extended, in Bowery Bay	12.5	16
No. QU-30	From 35th Street, extended, in Bowery Bay to the eastern end of Rikers Island which includes the entire south shore	12.7	16
No. QU-40	North shore Rikers Island, extending east to 25th Avenue, extended, towards Flushing Bay	12.9	16
No. QU-50	From 25th Avenue, extended, towards Flushing Bay to 128th Street, extended	13.0	16
No. QU-60	From 128th Street, extended seaward, to Bronx-Whitestone Bridge on the East River	13.2	17
No. QU-70	From the Bronx-Whitestone Bridge to 161st Street, extended	13.5	17
No. QU-80	From 161st Street, extended, to West Drive, extended	13.8	20
No. QU-90	From West Drive, extended, to 37th Avenue, extended, northeast to county boundary	12.9	15

3.5 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NGVD 29. Structure and ground elevations in the community must, therefore, be referenced to NGVD 29. It is important to note that adjacent communities may be referenced to NAVD 88. This may result in differences in base flood elevations across the corporate limits between the communities.

For more information on NAVD of 1988, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 100-year floodplain data, which may include a combination of the following: 10-, 50-, 100-, and 500-year flood elevations; delineations of the 100-year and 500-year floodplains; and 100-year floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (U.S. Department of the Interior, Geological Survey [USGS], 1975, et cetera).

For the approximate analysis in the July 5, 1994, revision, the 100-year floodplain boundaries were delineated using maps supplied by the city and topographic information from maps at a scale of 1:24,000 with a contour interval of 10 feet (USGS, 1975, et cetera). For the Borough of Staten Island, the boundaries were interpolated between cross sections using topographic maps at a scale of 1:960 with a contour interval of 2 feet (Aerial Data Reduction Associates, Inc., 1989).

For the approximate analysis on Staten Island in the May 21, 2001, revision, the 100-year floodplain boundaries were delineated using topographic maps supplied by the NYCDEP, at a scale of 1:400, with a contour interval of 2 feet (NYCDEP, 1999).

In the May 21, 2001, revision, the tidal areas of Brooklyn, Queens, and Staten Island, the flood boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (NYSDEC, 1979). In addition, for the Borough of Manhattan, flood boundaries were delineated using topographic maps at a scale of 1:960 with a contour interval of 2 feet (Phillips & Associates of Liverpool, 1980).

For this revision, all unrevised, detailed study flood hazard boundaries were redelineated using topographic maps at a scale of 1:1,200, with a contour interval of

2 feet as well as a 3 meter digital elevation model (NYC DOITT). For the revised analyses of the Bronx River, D Street Brook, Forest Hill Road Tributary, Richmond Creek as well as Eibs Pond and Stump Pond, the 3 meter digital elevation model was used to delineate boundaries between hydraulic cross sections. The remaining revised analyses were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (NYC DEP).

The 100- and 500-year floodplain boundaries are shown on the FIRM (Exhibit 2). On these maps, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and VE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 7). The computed floodways are shown on the revised FIRM (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway for the Bronx River extend beyond the corporate limits. The 100-year discharges for Colon Tributary are contained within the storm drain. Therefore, a floodway was not computed.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 7, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Arbutus Creek								
A	350	414	2,298	0.2	10.2	8.5[2]	8.5	0.0
B	1,100	254	1,140	0.4	10.2	8.5[2]	8.5	0.0
C	2,136	68	446	1.1	15.2	15.2	15.2	0.0
D	2,496	56	212	1.6	15.2	15.2	15.2	0.0
E	3,170	116	98	3.5	21.6	21.6	21.6	0.0
F	3,690	12	47	6.5	26.8	26.8	27.2	0.4
G	3,860	25	79	3.9	30.4	30.4	30.4	0.0
H	4,620	16	61	5.0	31.5	31.5	32.3	0.8
I	5,340	87	76	3.3	36.9	36.9	36.9	0.0
J	5,940	15	41	6.1	40.1	40.1	40.1	0.0
K	6,460	10	28	8.9	47.8	47.8	47.9	0.1
L	6,850	46	165	1.2	52.5	52.5	53.1	0.6
M	7,130	24	53	3.6	52.6	52.6	53.1	0.5
N	7,690	77	180	1.1	56.6	56.6	56.6	0.0

[1]Feet above Arbutus Lake outlet
[2]Elevation computed without consideration of backwater effects from Raritan Bay

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

ARBUTUS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Blue Heron Main Branch								
A	0[1]	25	63	5.4	10.2	6.1[3]	6.6	0.5
B	380[1]	177	828	0.4	10.2	7.4[3]	8.3	0.9
C	900[1]	96	433	0.8	10.2	7.5[3]	8.4	0.9
D	1,322[1]	80	669	0.5	17.1	17.1	17.1	0.0
E	1,570[1]	10	38	9.0	17.0	17.0	17.3	0.3
F	2,050[1]	38	131	2.6	25.1	25.1	26.1	1.0
G	2,510[1]	55	62	5.5	31.7	31.7	31.8	0.1
H	3,000[1]	85	151	1.3	36.2	36.2	37.0	0.8
I	3,590[1]	22	30	6.7	42.2	42.2	42.2	0.0
J	3,900[1]	16	26	7.3	45.6	45.6	45.8	0.2
K	4,540[1]	32	130	1.5	47.8	47.8	47.8	0.0
L	5,030[1]	50	276	0.6	54.2	54.2	54.8	0.6
M	5,600[1]	10	13	6.6	63.3	63.3	63.3	0.0
N	6,200[1]	10	22	3.9	67.1	67.1	67.4	0.3
O	6,500[1]	140	593	0.1	69.5	69.5	69.6	0.1
Blue Heron Tributary								
A	490[2]	7	23	5.5	36.2	35.6[4]	36.6	1.0
B	640[2]	30	16	3.4	40.3	40.3	40.3	0.0
C	1,320[2]	40	20	2.6	48.2	48.2	48.3	0.1
D	1,520[2]	204	903	0.1	49.6	49.6	49.8	0.2
E	2,020[2]	7	16	5.2	56.2	56.2	56.8	0.7
F	2,273[2]	15	15	5.6	65.0	65.0	65.0	0.0

[1]Feet above confluence with Raritan Bay
[2]Feet above confluence with Blue Heron Main Branch
[3]Elevation computed without consideration of backwater effects from Raritan Bay
[4]Elevation computed without consideration of backwater effects from Blue Heron Main Branch

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

BLUE HERON MAIN BRANCH – BLUE HERON TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bronx River								
A	3,600	169	4,008	1.0	13.0	[3]	14.0	1.0
B	6,900	160	3,166	1.3	13.0	[3]	14.0	1.0
C	8,390	180	3,929	1.0	13.1	13.1	14.1	1.0
D	9,300	310	4,389	0.9	13.1	13.1	14.1	1.0
E	10,900	90	1,578	2.6	13.3	13.3	14.3	1.0
F	12,200	138	2,353	1.7	13.5	13.5	14.5	1.0
G	13,820	86	1,214	3.4	13.9	13.9	14.9	1.0
H	14,970	75	763	5.4	14.4	14.4	15.4	1.0
I	16,040	94	768	5.3	28.7	28.7	29.3	0.6
J	18,430	203	1,890	2.2	29.9	29.9	30.3	0.4
K	19,600	99	776	5.3	30.6	30.6	30.9	0.3
L	21,850	89	472	8.7	41.1	41.1	41.4	0.3
M	23,390	110	648	6.3	53.7	53.7	53.7	0.0
N	25,000	117	776	5.3	56.3	56.3	53.4	-2.9
O	27,320	82	572	7.2	57.6	57.6	57.9	0.3
P	28,270	63	700	5.9	61.1	61.1	61.3	0.2
Q	29,960	69	798	5.1	62.0	62.0	62.8	0.8
R	30,960	91	1,090	3.6	64.2	64.2	64.8	0.6
S	33,150	91	856	4.5	65.1	65.1	65.8	0.7
T	35,150	63	755	5.1	66.5	66.5	67.2	0.7
U	36,270	63	803	4.8	67.1	67.1	67.9	0.8
V	37,260	100	1,005	3.9	69.3	69.3	70.0	0.7
W	38,310	86	943	4.1	70.0	70.0	70.8	0.8
X	39,070	132	1,242	3.0	70.7	70.7	71.4	0.7
Y	40,180	92[2]	860	4.5	71.2	71.2	71.9	0.7
Z	41,310	91[2]	1,053	3.7	72.2	72.2	72.9	0.7

[1]Feet above confluence with the East River
[2]Width extends beyond county boundary
[3]Elevation computed without consideration of tidal effects from the East River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

BRONX RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Butler Manor								
A	1,550[1]	152	387	0.3	10.2	9.9[4]	10.9	1.0
B	1,838[1]	13	17	5.3	10.8	10.8	10.9	0.9
C	2,170[1]	11	25	2.4	14.8	14.8	15.3	0.5
D	2,440[1]	8	17	3.8	24.2	24.2	24.5	0.3
E	2,600[1]	20	15	4.1	26.5	26.5	26.5	0.0
F	2,935[1]	330	1,315	0.1	33.3	33.3	33.5	0.2
'D' Street Brook								
A	0[2]	154	69	2.8	96.5	96.5	96.5	0.0
B	356[2]	64	42	4.6	102.8	102.8	102.8	0.0
C	695[2]	20	28	6.8	112.5	112.5	112.5	0.0
D	990[2]	33	33	5.8	125.4	125.4	125.4	0.0
E	1,237[2]	27	31	6.1	138.4	138.4	138.4	0.0
F	1,532[2]	49	32	6.0	154.7	154.7	154.7	0.0
Denise Tributary								
A	460[3]	38	24	4.6	23.2	23.2	23.2	0.0
B	640[3]	40	95	1.1	27.5	27.5	27.8	0.3
C	880[3]	9	19	5.8	29.0	29.0	29.3	0.3
D	1,200[3]	6	19	5.8	33.7	33.7	34.5	0.8
E	1,530[3]	26	21	5.2	39.2	39.2	39.2	0.0
F	2,000[3]	23	28	3.9	51.1	51.1	51.1	0.0

[1]Feet above confluence with Raritan Bay
[2]Feet above 'D' Street culvert
[3]Feet above confluence with Arbutus Creek
[4]Elevation computed without consideration of backwater effects from Raritan Bay

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

BUTLER MANOR – 'D' STREET BROOK – DENISE TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Eltingville Tributary								
A	170[1]	20	58	9.7	38.7	35.5[4]	38.7	0.0
B	360[1]	18	86	6.5	39.6	39.6	39.8	0.2
Forest Hill Road Brook								
A	440[2]	30	106	5.2	5.0	5.0	5.8	0.8
B	1,467[2]	44	144	3.1	6.0	6.0	7.0	1.0
C	3,061[2]	26	77	2.6	13.6	13.6	13.6	0.0
D	3,366[2]	26	53	3.7	13.9	13.9	14.0	0.1
E	3,737[2]	24	31	6.5	24.9	24.9	24.9	0.0
F	4,010[2]	22	30	6.7	32.7	32.7	32.8	0.1
G	4,247[2]	30	45	4.5	39.4	39.4	39.9	0.5
H	4,462[2]	22	30	6.6	46.9	46.9	46.9	0.0
I	4,664[2]	21	30	6.8	51.7	51.7	51.9	0.2
J	5,040[2]	26	45	4.4	57.1	57.1	58.0	0.9
K	5,236[2]	33	36	5.6	58.0	58.0	58.8	0.8
L	5,615[2]	74	146	1.4	60.4	60.4	60.9	0.5
M	5,953[2]	71	69	2.9	67.5	67.5	62.8	0.3
N	6,232[2]	40	41	4.9	66.0	66.0	66.2	0.2
O	6,652[2]	20	29	6.9	73.6	73.6	73.7	0.1
Jansen Tributary								
A	340[3]	40	13	3.1	24.9	24.9	24.9	0.0
B	800[3]	48	24	1.7	29.9	29.9	29.9	0.0
C	1,080[3]	48	13	3.0	32.4	32.4	32.4	0.0
D	1,340[3]	44	13	3.1	41.0	41.0	41.0	0.0

[1]Feet above confluence with Sweet Brook
[2]Feet above confluence with Richmond Creek
[3]Feet above confluence with Arbutus Creek
[4]Elevation computed without consideration of backwater effects from Sweet Brook

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

ELTINGVILLE TRIBUTARY – FORESTHILL BROOK – JANSEN TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lemon Creek								
A	7,135	118	866	0.6	17.4	17.4	17.4	0.0
B	7,700	53	351	1.5	17.4	17.4	17.4	0.0
C	7,975	130	585	0.9	17.5	17.5	17.6	0.1
D	8,350	42	68	7.8	17.5	17.5	17.5	0.0
E	8,480	37	79	6.7	18.8	18.8	18.8	0.0
F	8,680	42	77	6.8	21.3	21.3	21.3	0.0
G	9,150	30	75	4.0	27.1	27.1	27.3	0.2
H	9,600	26	75	4.0	30.4	30.4	31.1	0.7
I	9,920	11	31	9.6	34.3	34.3	34.3	0.0
J	10,520	25	38	5.5	39.6	39.6	39.6	0.0
K	11,280	56	146	1.4	42.6	42.6	43.4	0.8
L	11,830	38	44	4.7	45.7	45.7	45.7	0.0
M	12,730	75	68	3.1	51.8	51.8	51.8	0.0
N	13,650	58	70	3.0	57.6	57.6	57.6	0.0
O	14,130	35	50	3.8	59.8	59.8	60.1	0.3
P	14,630	21	40	4.7	63.7	63.7	63.7	0.0
Q	15,230	31	42	4.5	69.6	69.6	69.6	0.0
R	15,510	50	261	0.7	73.7	73.7	73.7	0.0
S	15,760	25	12	0.2	77.3	77.3	77.3	0.0
T	16,103	20	3	1.1	81.1	81.1	81.1	0.0
U	16,400	63	53	0.1	83.4	83.4	83.4	0.0
V	16,800	265	306	0.2	83.4	83.4	83.4	0.0
W	17,150	32	18	4.3	87.5	87.6	87.5	0.1
X	17,440	35	28	2.8	93.5	93.6	93.5	0.1
Y	17,650	50	149	0.3	99.4	99.4	99.4	0.0
Z	17,920	47	23	2.0	101.3	101.7	101.3	0.4

[1]Feet above confluence with Raritan Bay

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

LEMON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mill Creek								
A	1,775[1]	200	977	1.7	9.8	8.9[5]	9.7	0.8
B	2,780[1]	254	764	2.2	9.8	9.2[5]	9.7	0.5
C	3,815[1]	43	100	8.6	14.8	14.8	15.0	0.2
D	4,500[1]	107	189	4.4	22.3	22.3	22.5	0.2
E	5,240[1]	25	111	7.5	27.3	27.3	27.5	0.2
F	5,710[1]	49	503	1.3	35.8	35.8	36.0	0.2
G	6,350[1]	110	447	1.1	40.5	40.5	40.8	0.3
H	6,640[1]	41	126	2.1	41.3	41.3	41.6	0.3
I	6,965[1]	11	43	6.1	41.5	41.5	41.7	0.2
J	7,570[1]	18	21	5.5	51.2	51.2	51.2	0.0
K	8,215[1]	50	32	3.6	66.1	66.1	66.1	0.0
L	8,805[1]	90	36	3.1	77.4	77.4	77.4	0.0
Mill Creek Tributary 1								
A	370[2]	14	29	8.4	44.7	44.7	44.7	0.0
B	800[2]	20	45	5.5	49.8	49.8	49.8	0.0
C	1,260[2]	36	42	5.9	54.3	54.3	54.3	0.0
D	1,630[2]	35	40	6.2	60.3	60.3	60.3	0.0
Mill Creek Tributary 2								
A	450[3]	50	101	8.2	11.8	11.8	11.8	0.0
B	1,450[3]	87	161	3.7	12.5	12.5[6]	13.0	0.5
Mill Creek Tributary 3								
A	300[4]	38	43	6.1	15.9	15.9	15.9	0.0
B	860[4]	40	78	3.4	22.3	22.3	22.3	0.0

[1]Feet above confluence with Arthur Kill
[2]Feet above confluence with Mill Creek Main
[3]Feet above confluence with Mill Creek
[4]Feet above confluence with Mill Creek Tributary 2
[5]Elevation computed without consideration of backwater effects from Arthur Kill
[6]Elevation computed without consideration of backwater effects from Mill Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

MILL CREEK – MILL CREEK TRIBUTARY 1 – MILL CREEK TRIBUTARY 2 – MILL CREEK TRIBUTARY 3

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Richmond Creek								
A	14,999	99	348	3.4	5.8	5.8	6.8	1.0
B	15,345	42	249	4.7	7.7	7.7	8.7	1.0
C	15,887	121	762	1.5	12.6	12.6	13.5	0.9
D	16,246	160	238	4.9	13.6	13.6	13.6	0.0
E	16,600	97	538	2.2	14.6	14.6	14.6	0.0
F	17,669	37	156	7.5	16.7	16.7	17.3	0.6
G	18,227	231	937	1.3	19.2	19.2	20.2	1.0
H	19,019	47	139	8.4	22.5	22.5	22.8	0.3
I	19,526	47	242	4.8	26.5	26.5	27.5	1.0
J	20,060	28	111	10.5	30.9	30.9	31.9	1.0
K	20,534	41	159	7.4	37.8	37.8	38.5	0.7
L	20,822	52	148	7.9	43.0	43.0	43.5	0.5
M	21,212	25	102	11.5	50.7	50.7	50.9	0.2
N	21,746	50	76	6.8	61.1	61.1	61.1	0.0
O	22,138	12	51	10.0	76.5	76.5	76.6	0.1
P	22,743	25	58	8.8	91.7	91.7	91.7	0.0
Q	23,368	23	67	7.7	106.0	106.0	106.4	0.4
R	23,847	41	166	3.1	116.6	116.6	116.7	0.1
S	24,203	28	64	3.6	121.3	121.3	122.3	1.0
T	24,931	41	47	4.9	131.3	131.3	131.3	0.0
U	25,605	35	48	4.8	145.6	145.6	145.6	0.0
V	26,079	5	20	11.6	165.2	165.2	165.6	0.4
W	26,679	15	29	8.0	186.4	186.4	186.4	0.0
X	27,319	13	28	8.4	215.7	215.7	215.7	0.0
Y	28,065	12	26	8.7	245.5	245.5	245.5	0.0
Z	28,664	18	69	3.4	254.4	254.4	254.5	0.1

[1]Feet upstream of confluence with the Fresh Kill

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

RICHMOND CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sandy Brook								
A	480[1]	12	24	3.5	39.2	39.2	39.2	0.0
B	850[1]	14	15	5.4	43.3	43.3	43.3	0.0
C	1,200[1]	12	18	4.6	48.8	48.8	48.9	0.1
D	1,600[1]	10	13	6.5	52.3	52.3	52.3	0.0
E	2,000[1]	63	45	1.8	58.0	58.0	58.1	0.1
F	2,400[1]	123	52	1.6	63.4	63.4	63.5	0.1
G	2,890[1]	14	11	5.1	69.4	69.4	69.4	0.0
H	3,220[1]	13	15	3.9	73.6	73.6	73.6	0.0
I	3,600[1]	10	10	5.6	81.3	81.3	81.3	0.0
Sweet Brook								
A	3,420[2]	25	96	11.1	15.1	15.1	15.1	0.0
B	3,690[2]	34	146	7.3	18.4	18.4	18.4	0.0
C	4,275[2]	68	131	6.9	29.2	29.2	29.3	0.1
D	4,865[2]	58	253	3.6	30.3	30.3	30.8	0.5
E	5,280[2]	75	586	1.7	30.7	30.7	31.6	0.9
F	5,715[2]	129	709	1.4	30.8	30.8	31.7	0.9
G	6,250[2]	50	292	3.5	31.6	31.6	32.2	0.6
H	6,760[2]	95	741	1.3	38.3	38.3	38.6	0.3
I	7,220[2]	90	523	0.8	38.4	38.4	38.6	0.2
J	8,100[2]	72	54	4.9	46.9	46.9	46.9	0.0
K	8,600[2]	50	47	5.6	51.9	51.9	52.0	0.1
L	9,450[2]	50	47	5.6	56.9	56.9	56.9	0.0
M	10,259[2]	55	43	5.1	65.1	65.1	65.1	0.0
N	10,455[2]	48	74	4.8	66.1	66.1	66.5	0.4
O	11,125[2]	21	69	5.1	71.2	71.2	71.8	0.6
P	12,020[2]	28	63	5.6	76.3	76.3	76.5	0.2

[1]Feet above confluence with Lemon Creek
[2]Feet above confluence with Richmond Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

FLOODWAY DATA

SANDY BROOK – SWEET BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sweet Brook (continued)								
Q	12,585[1]	49	251	1.2	81.6	81.6	81.9	0.3
R	12,870[1]	24	106	2.9	81.8	81.8	82.2	0.4
S	13,389[1]	55	368	0.2	82.1	82.1	82.9	0.8
T	13,775[1]	68	261	0.2	82.1	82.1	82.9	0.8
U	14,395[1]	94	498	0.1	82.1	82.1	82.9	0.8
V	14,795[1]	142	256	1.2	82.2	82.2	83.0	0.8
W	15,055[1]	42	83	3.6	83.8	83.8	84.2	0.4
X	15,340[1]	10	47	5.9	84.5	84.5	85.0	0.5
Y	15,945[1]	108	306	0.9	87.0	87.0	87.6	0.6
Z	16,220[1]	17	52	4.9	88.2	88.2	88.7	0.5
Wolfe's Pond								
A	1,220[2]	120	483	0.9	10.1	9.2[3]	10.0	0.7
B	1,940[2]	610	3,820	0.1	10.1	9.3[3]	10.0	0.7
C	3,330[2]	182	854	0.5	10.1	9.3[3]	10.0	0.0
D	3,950[2]	20	47	8.7	10.1	10.0[3]	10.0	0.0
E	4,400[2]	23	53	7.7	16.8	16.8	16.9	0.1
F	4,580[2]	40	153	2.7	18.5	18.5	18.7	0.2
G	4,930[2]	43	248	1.4	21.4	21.4	22.4	1.0

[1]Feet above confluence with Richmond Creek
[2]Feet above confluence with Princes Bay
[3]Elevation computed without consideration of backwater effects from Princes Bay

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY
(BRONX, KING, NEW YORK, RICHMOND, AND QUEENS COS.)

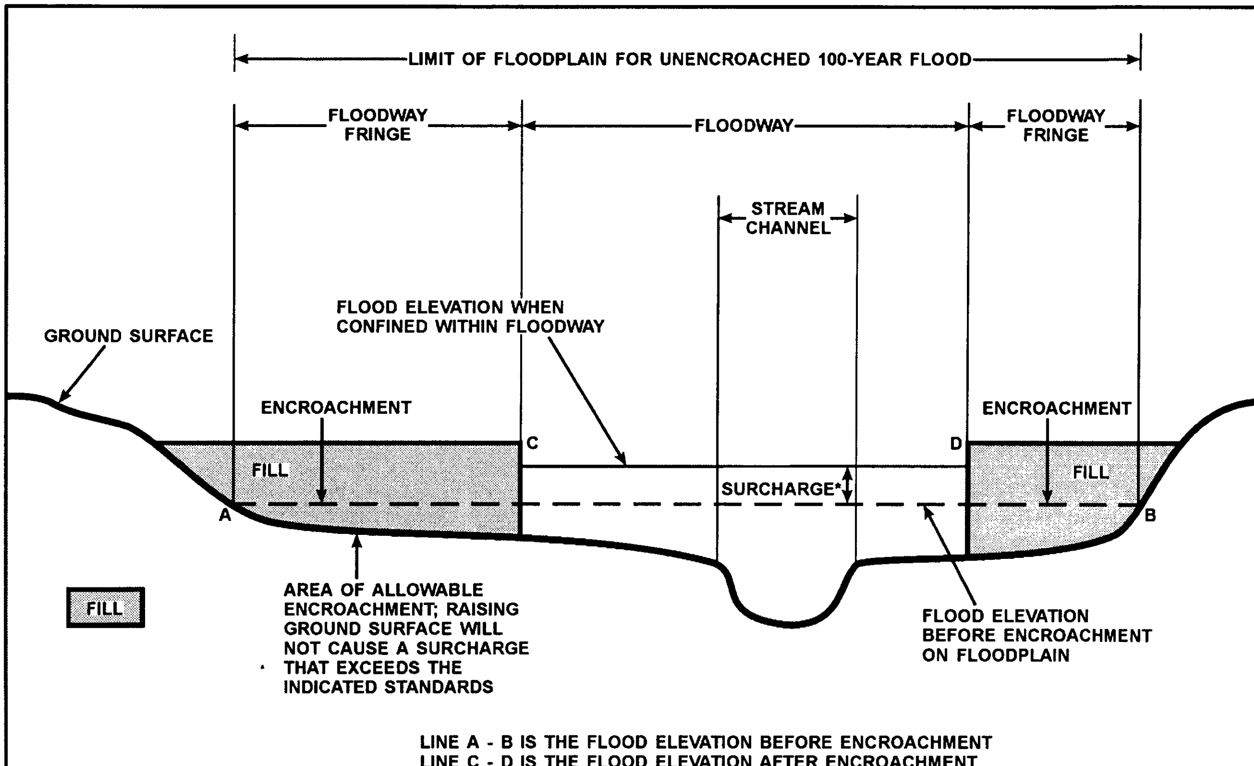
FLOODWAY DATA

SWEET BROOK – WOLFE'S POND

TABLE 7

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 7 for certain downstream cross sections of Arbutus Creek, Blue Heron Main Branch, Butler Manor, Mill Creek, Mill Creek Tributary 2, and Wolfe's Pond are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3, "Floodway Schematic."



*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEDERAL EMERGENCY MANAGEMENT AGENCY REQUIREMENT) OR LESSER HEIGHT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 3

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. On selected FIRM panels, floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

Due to its political and economic importance, and history of flood-related problems, the City of New York and surrounding areas have undergone numerous other hydrologic studies. A summary of these studies is provided in Study Overview (Camp, Dresser and McKee, 1983).

Because it is based on more up-to-date topographic information, this FIS supersedes the previously printed FIS for the City of New York (FEMA, 2001).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, Mitigation Division, 26 Federal Plaza, Room 1337, New York, New York 10278.

9.0 BIBLIOGRAPHY AND REFERENCES

Aerial Data Reduction Associates, Inc. (July 1989). New Jersey, Topographic Maps, Scale 1:960, Contour Interval 2 Feet. Borough of Staten Island, New York.

American Society of Civil Engineers. (November 1964). Journal of Hydraulic Division, Hydraulic Studies of Jamaica Bay. Armando Balloffet and A. Kupterman (authors).

Benjamin, J. R., and C. A. Cornell. (1970). Probability, Statistics, and Decision for Engineers. New York: McGraw-Hill.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (January 1983). Study Overview, Report No. 2. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (January 1982). Statistical Methodology - Statistical Analysis of Hurricanes, Report No. 3. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (April 1981). Analysis of Fluvial Flooding, Report No. 4. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (December 1981). Simulation Methodology for Northeasters, Report No. 6. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (November 1981). Total Stillwater Elevations - Implementation and Results, Report No. 7. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (November 1981). Wave Crest Analysis, Report No. 8. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (November 1980). Simulation of Hurricanes, Report No. 5. Annandale, Virginia.

Camp, Dresser and McKee, prepared for State of New York, Department of Environmental Conservation. (November 1979). Review of Existing Conditions and Preliminary Assessment, Report No. 1. Annandale, Virginia.

Camp, Dresser and McKee, Inc. (1977). Background Data for the City of Yonkers Flood Insurance Study. (Unpublished). Annandale, Virginia.

Camp, Dresser and McKee, Inc. (December 1977). Dynamic Estuary Model (DEM), prepared for Berkeley, Charleston and Dorchester Counties, South Carolina. Annandale, Virginia.

Chow, Ven Te. (1964). Handbook of Applied Hydrology. New York: McGraw-Hill.

Chow, Ven Te. (1959). Open-Channel Hydraulics. New York: McGraw-Hill.

City of New York, Department of Information Technology and Telecommunications (NYC DOITT) (2004). Topographic maps, Boroughs of the Bronx, Brooklyn, Manhattan, Queens and Staten Island, New York. Scale 1:1,200, Contour Interval 2 feet. New York, New York.

Federal Emergency Management Agency. (January 21, 1998). Flood Insurance Study, City of Yonkers, Westchester County, New York. Washington, D.C.

Federal Emergency Management Agency. (July 5, 1994). Flood Insurance Study, City of New York, Bronx, Queens, New York, Kings, and Richmond Counties, New York, Washington, D.C.

Federal Emergency Management Agency. (November 1, 1984). Flood Insurance Study, Town of Rye, Westchester County, New York. Washington, D.C.

Federal Emergency Management Agency. (February 1981). Users Manual for Wave Height Analysis. Washington, D.C.

Federal Emergency Management Agency. (January 1981). Computer Program for Determining Wave Height Elevations for Flood Insurance Studies. Washington, D.C.

Hammersley, J. M., and D. C. Handscomb. (1967). Monte Carlo Methods. London, England: Methuen and Co., Ltd.

Harris-Toups Associates of Lake Success. (1979). Methodology for Long Island Flood Insurance Studies. New York. (Unpublished).

Keystone Aerial Surveys, Inc., of Philadelphia, Pennsylvania. (City of New York, flown in April 1978 and April 1979). Aerial Photographs, Scale 1:12,000.

Lawler, Matusky & Skelly Engineers of Pearl River, New York. (June 1979). Personnel Communication. (Unpublished).

Leendertste, J. J. (1970-1973). A Water Quality Simulation Model for Well-Mixed Estuaries and Coastal Seas, Volumes I-VI. New York, New York: Rand Corporation.

Leonard Jackson and Associates of Pomona, New York. (November 2005).

National Academy of Sciences. (1977). Methodology for Calculating Wave Action Effects Associated with Storm Surges. Washington, D.C.

New York City, Department of Environmental Protection. (1999). Topographic Maps. Scale 1:400, Contour Interval 2 Feet. New York.

New York State, Department of Environmental Conservation. (1979). Topographic Maps, Boroughs of the Bronx, Brooklyn, Queens, and Staten Island, New York. Scale 1:4,800, Contour Interval 2 Feet. Albany, New York.

New York Sea Grant Institute. (1976). MESA New York Bight Atlas, Monograph 6, Storm Surge. N. A. Pore and C. S. Barrientos (authors). Albany, New York.

New York Times. (September 7, 1979). New York, New York.

New York Times. (November 10, 1977). New York, New York.

New York Times. (November 9, 1977). New York, New York.

New York Times. (August 10, 1976). New York, New York.

New York Times. (August 25, 1975). New York, New York.

New York Times. (September 27, 1975). New York, New York.

New York Times. (October 30, 1973). New York, New York.

New York Times. (October 31, 1973). New York, New York.

New York Times. (November 9, 1972). New York, New York.

New York Times. (June 21, 1972). New York, New York.

New York Times. (August 28, 1971). New York, New York.

Phillips & Associates of Liverpool, New York. (July 1980). Topographic Sectional Maps. Scale 1:960, Contour Interval 2 Feet. Borough of Manhattan, New York.

R. A. Murdoff. (1959). The Climate of New York State. Cornell Miscellaneous Bulletin 33. Ithaca, New York.

State of New Jersey, Department of Environmental Protection, Division of Water Resources, in cooperation with the U.S. Geological Survey. (1974). Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization. Special Report 38. Stephen J. Stankowski (author). Trenton, New Jersey.

State of New York. Freshwater Wetlands Map. Scale 1:28,800.

Southold Town Planning Board. (March 1975). Flood Plain Study for Southold Town, New York. Southold, New York.

State of New York, Economic Development Board. (1973). Land Use and Natural Resources Inventory of New York State. Albany, New York.

Stone & Webster Engineering Corp. of Boston, Massachusetts, prepared for the Federal Insurance Administration. (1978). Development and Verification of Synthetic Northeaster Model for Coastal Flood Analysis. Boston, Massachusetts.

Tetra Tech Inc. of Pasadena, California, prepared for Department of Housing and Urban Development. (May 1977). Coastal Flooding Handbook, Part 1 - Methodology and Part 11 - Code and Users Guide. Washington, D.C..

Texas A&M Research Foundation. (January 1959). The Prediction of Hurricane Storm-Tides in New York Bay. Technical Report No. 165-2. B. W. Wilson (author). College Station, Texas.

Thompson, J. H. (1966). Geography of New York State. Syracuse, New York: Syracuse University Press.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (September 1990). HEC-2 Water-Surface Profiles, Users Manual. Davis, California.

U.S. Army Corps of Engineers, North Atlantic Division. (1977). Water Resources Development in New York City. New York.

U.S. Army Corps of Engineers, Galveston District. (June 1975). Guidelines for Identifying Coastal High Hazard Zones. Galveston, Texas.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (October 1973). HEC-2 Water Surface Profiles, Generalized Computer Program. Davis, California.

U.S. Army Corps of Engineers, New England Division. (1979). Stage-Frequency Analysis Using Pearson Type III with Expected Probability. Waltham, Massachusetts.

U.S. Army Corps of Engineers, New England Division. (1979). Tidal Gages and Records at Willets Point, Stamford, Bridgeport, New London, Stonington, Providence, and Newport. Waltham, Massachusetts. (Unpublished).

U.S. Army Corps of Engineers, New York District. (1979). Weibull Plotting Positions Analysis for the Battery, Sandy Hook and East Newark. Albany, New York.

U.S. Army Corps of Engineers, New York District. (June 1972). Tidal Flood Plain Information: North Shore of Nassau County Long Island, New York. New York.

U.S. Army Corps of Engineers, North Atlantic Division. (1977). Water Resources Development in New York. New York.

U.S. Army Corps of Engineers, North Atlantic Division. (August 1963). Report on Operation Five High, March 1962 Storm. New York, New York.

U.S. Census Bureau (2000). http://quickfacts.census.gov

U.S. Department of Commerce, Bureau of the Census. (1981). 1980 Census of Population, Number of Inhabitants, New York. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Commerce, Environmental Science Services Administration. (April 1970). Joint Probability Method of Tide Frequency Analysis Applied to Atlantic City and Long Beach Island, New Jersey. Technical Memorandum WBTM, Hydro 11. V.A. Myers (author). Washington, D.C..

U.S. Department of Commerce, National Oceanic and Atmospheric Administration. (May 1975). Some Climatological Characteristics of Hurricanes and Tropical Storms. Technical Report NWS-15. Francis P. Ho, R. W. Schwerdt and H. V. Goodyear (authors). Asheville, North Carolina.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey. (June 1974). Tidal Bench Marks in New York. Asheville, North Carolina.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, prepared for National Weather Service. (1973). Storm Evacuation Map, T-15026 New York City, New York. Asheville, North Carolina.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration. (1973). Tropical Cyclone Data 993. Asheville, North Carolina.

U.S. Department of Commerce, National Bureau of Standards. (1959). Applied Math. Statistical Theory of Extreme Values and Some Practical Application. Series No. 33. E.J. Gumbel (author). Washington, D.C.

U.S. Department of Commerce, National Weather Service, Systems Development Office. (October 1980). Significant Northeaster Storm Surge Marigram 1956-1959. Arthur N. Pore (author). Silver Spring, Maryland.

U.S. Department of Commerce, National Weather Service. (September 1960). Surface Winds Near the Center of Hurricanes. National Hurricane Research Project, Report No. 39. H. E. Graham and G. N. Hudson (authors). Washington, D.C.

U.S. Department of Commerce, National Weather Service. (1959). Isovel Patterns for Hurricane Carol (1954). Memorandum HUR7-54. Washington, D.C.

U.S. Department of Commerce, National Weather Service. (March 1957). Survey of Meteorological Factors. National Hurricane Research Project, Report No. 5. Washington, D.C.

U.S. Department of Commerce, National Weather Service. (July 1956). Monthly Weather Reviews. Winds and Pressures Over the Sea in the Hurricane of September 1938. V. A. Myers and E. S. Jordan (authors). Boston, Massachusetts.

U.S. Department of Commerce, National Weather Service. (1956). Index of Tide Gage and Tide Gage Records for the Atlantic and Gulf Coasts of the United States. National Hurricane Research Project, Report No. 7. Washington, D.C.

U.S. Department of Commerce, Weather Bureau. (1965). Tropical Cyclones of the North Atlantic Ocean. Technical Paper No. 55. G. W. Cry (author). Washington, D.C.

U.S. Department of Commerce, Weather Bureau. (March 1962). Great Atlantic Coast Storm, 1962, Climatological Data, National Summary. Washington, D.C.

U.S. Department of Housing and Urban Development, Federal Insurance Administration. (November 15, 1979). Flood Insurance Study, City of Eastchester, Westchester County, New York. Washington, D.C.

U.S. Department of Housing and Urban Development, Federal Insurance Administration. (September 29, 1978). Flood Insurance Study, Village of Ardsley, Westchester County, New York. Washington, D.C.

U.S. Department of Housing and Urban Development, Federal Insurance Administration. (April 17, 1978 [Flood Insurance Study report]; October 17, 1978 [Flood Insurance Rate Map]). Flood Insurance Study, City of Mount Vernon, Westchester County, New York. Washington, D.C.

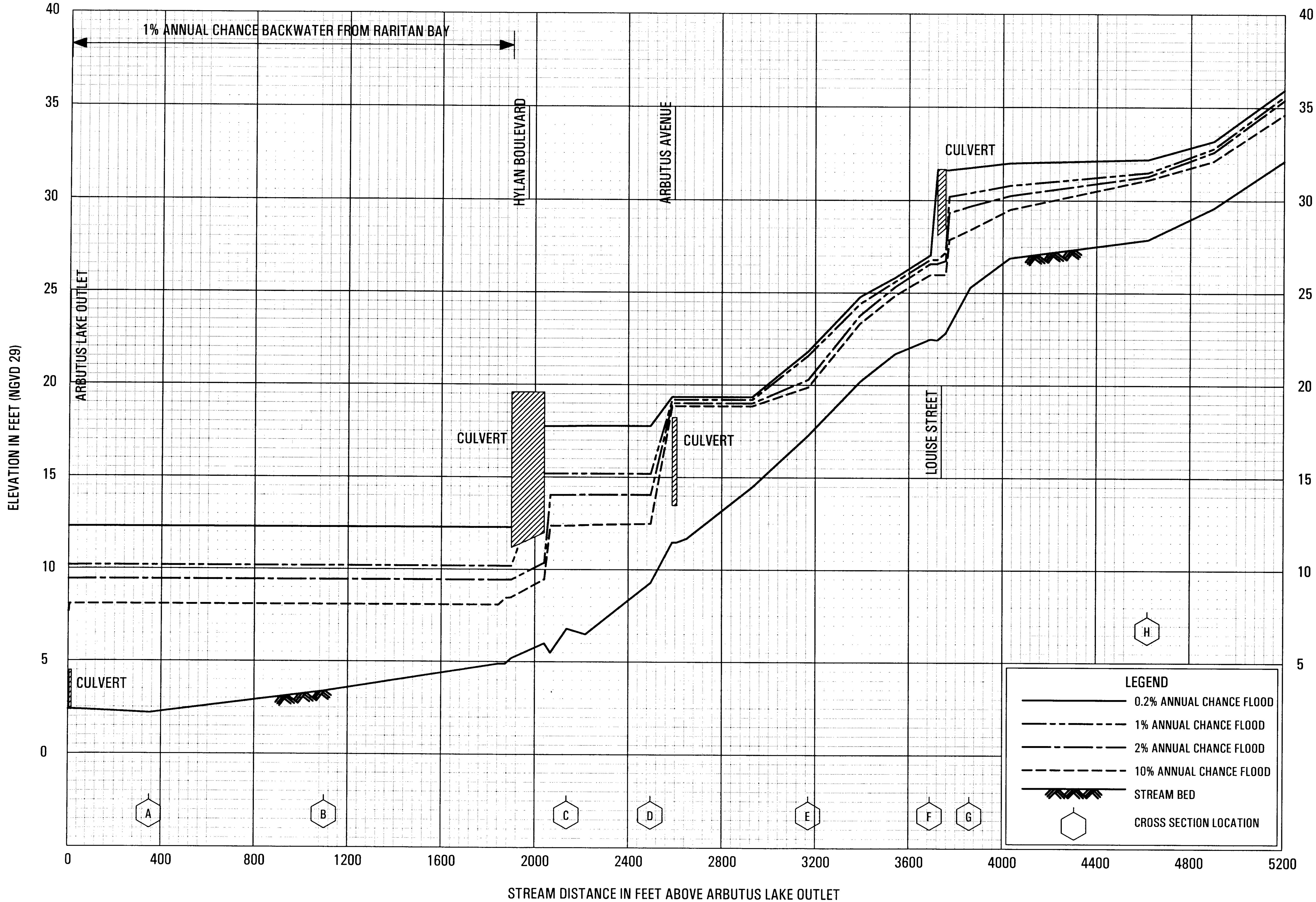
U.S. Department of the Interior, Geological Survey. (1979). Water Resources Data at Gage No. 01376500 on the Bronx River at Bronxville: Flood Records and High Water Marks for Floods of June 1972 and September 1975, WATSTORE. Reston, Virginia.

U.S. Department of the Interior, Geological Survey. (1967). Water-Supply Paper 1849, Roughness Characteristics of Natural Channels. Harry H. Barnes, Jr. (author). Washington, D.C.

U.S. Department of the Interior, Geological Survey. (Yonkers, New York, 1979; Lawrence, New York, 1977; Arthur Kill, New York, New Jersey, 1975; The Narrows, New York, New Jersey, 1975; Sea Cliff, New York, 1968; Elizabeth, New York, New Jersey, 1967; Flushing, New York, 1966; Jamaica, New York, 1957; Central Park, New York, New Jersey, 1956; Mount Vernon, New York, 1956; Brooklyn, New York, 1956; Jersey City, New York, New Jersey, 1955; Weekawken, New York, New Jersey, 1955; Coney Island, New York, New Jersey, 1955; Far Rockaway, New York, 1954; Lynbrook, New York, 1954). 7.5-Minute Series Topographic Maps. Scale 1:24,000, Contour Interval 10 Feet.

Van Dorn, W. C. (1953). Journal of Marine Research. Wind Stress on an Artificial Pond. Volume 12. New Haven, Connecticut.

Water Resources Council. (June 1977). Guidelines for Determining Flood Flow Frequency. Bulletin 17A. Washington, D.C.



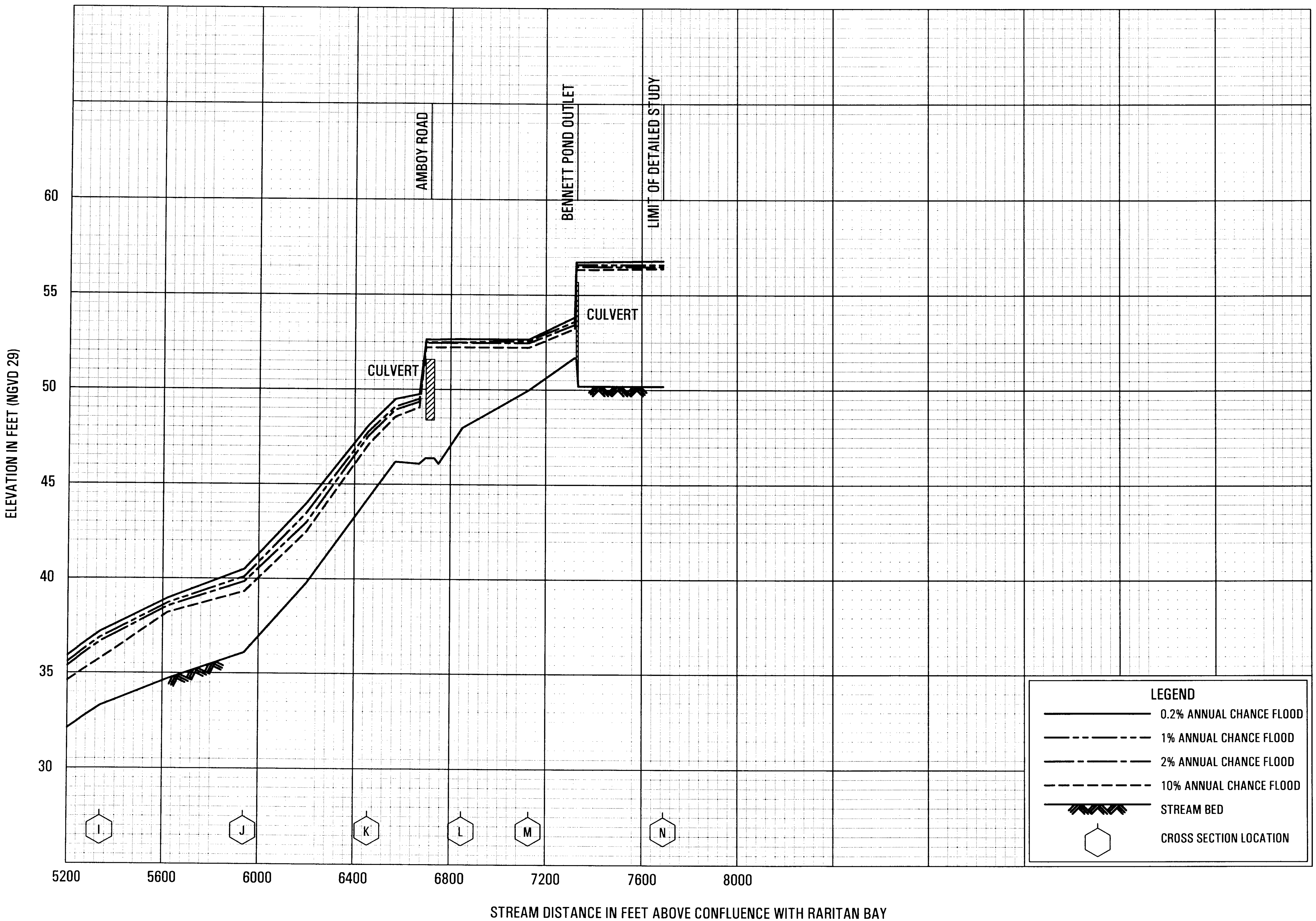
FLOOD PROFILES

ARBUTUS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

01P



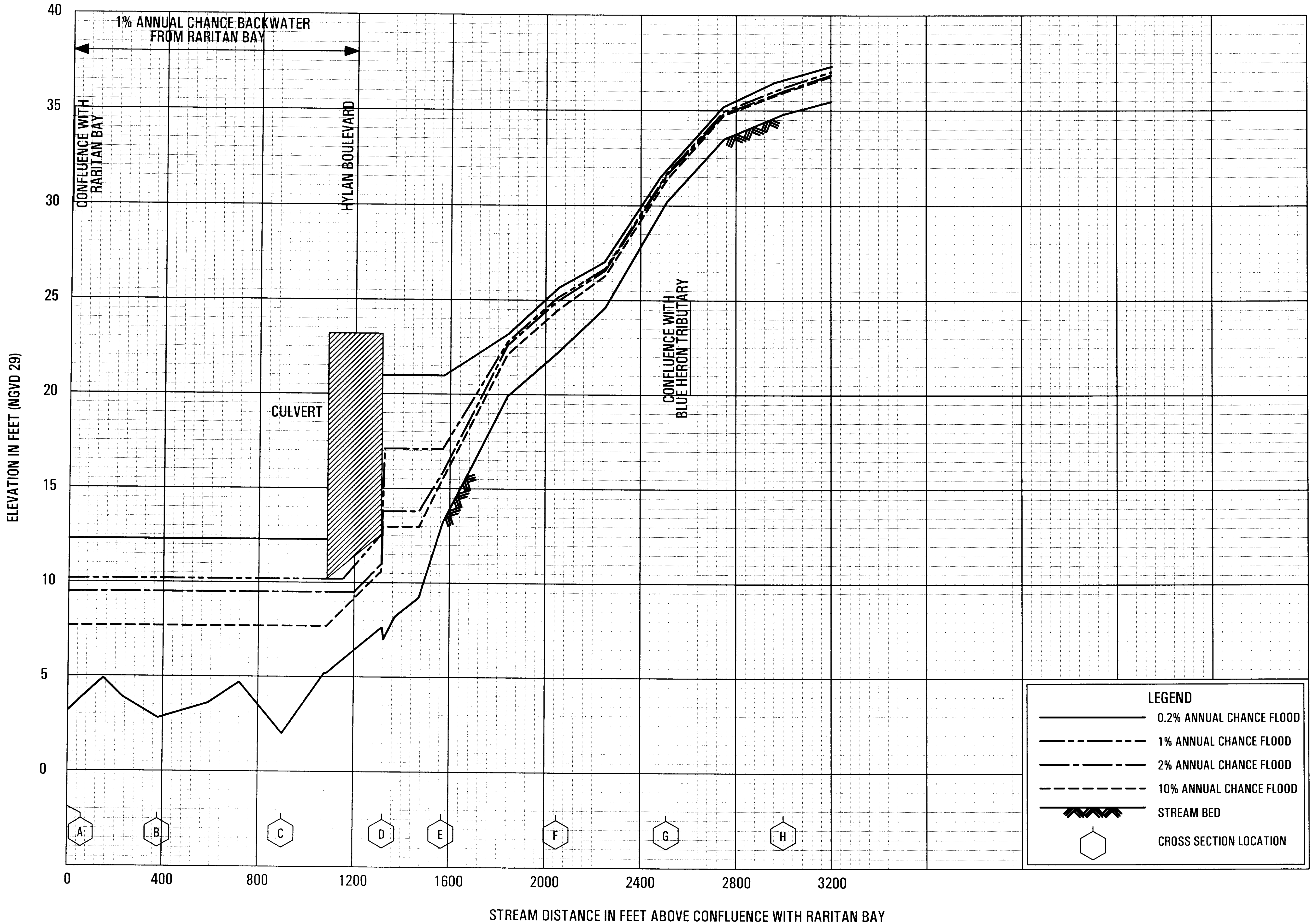
FLOOD PROFILES

ARBUTUS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

02P



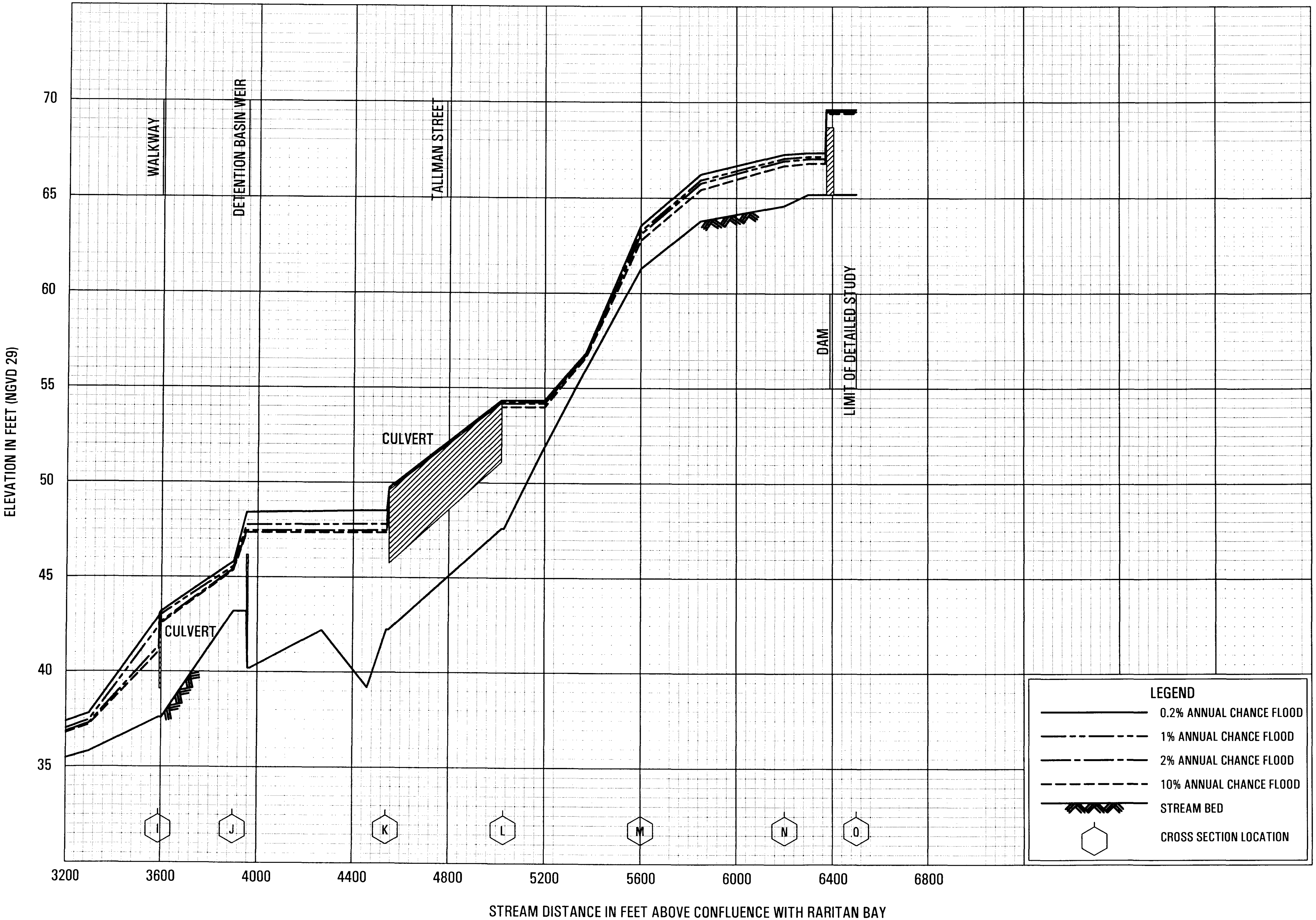
FLOOD PROFILES

BLUE HERON MAIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

03P



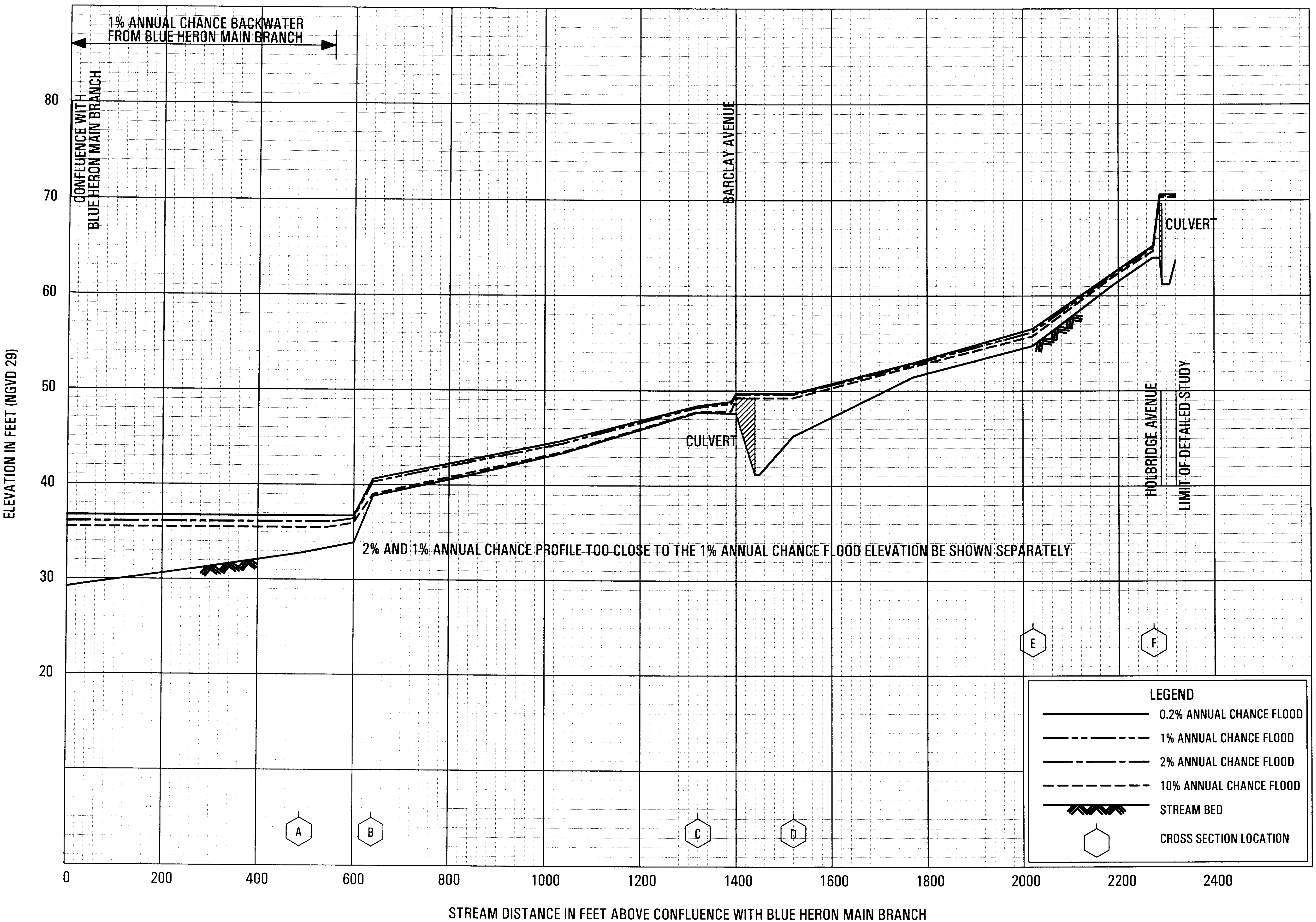
FLOOD PROFILES

BLUE HERON MAIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

04P

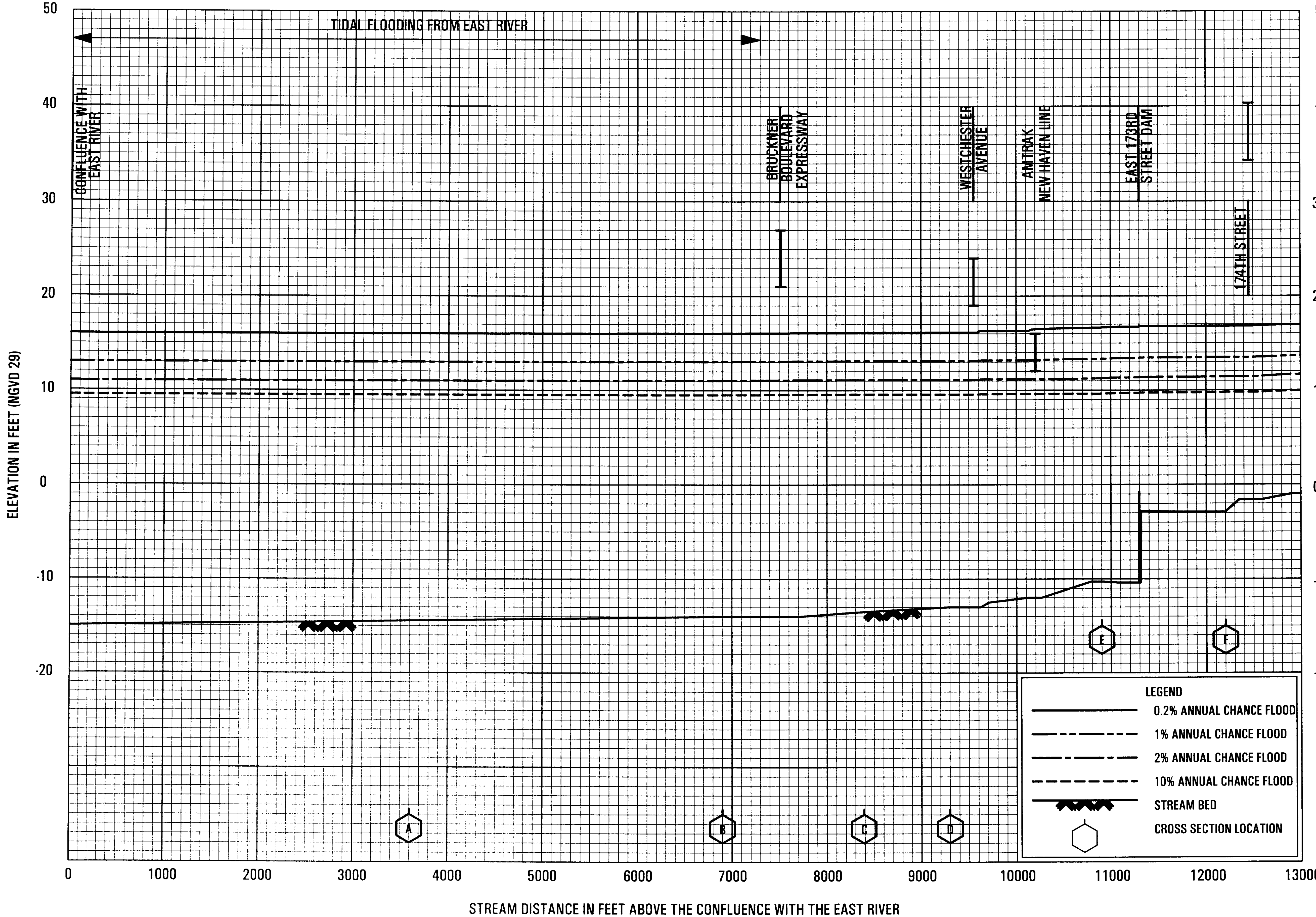


FLOOD PROFILES

BLUE HERON TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



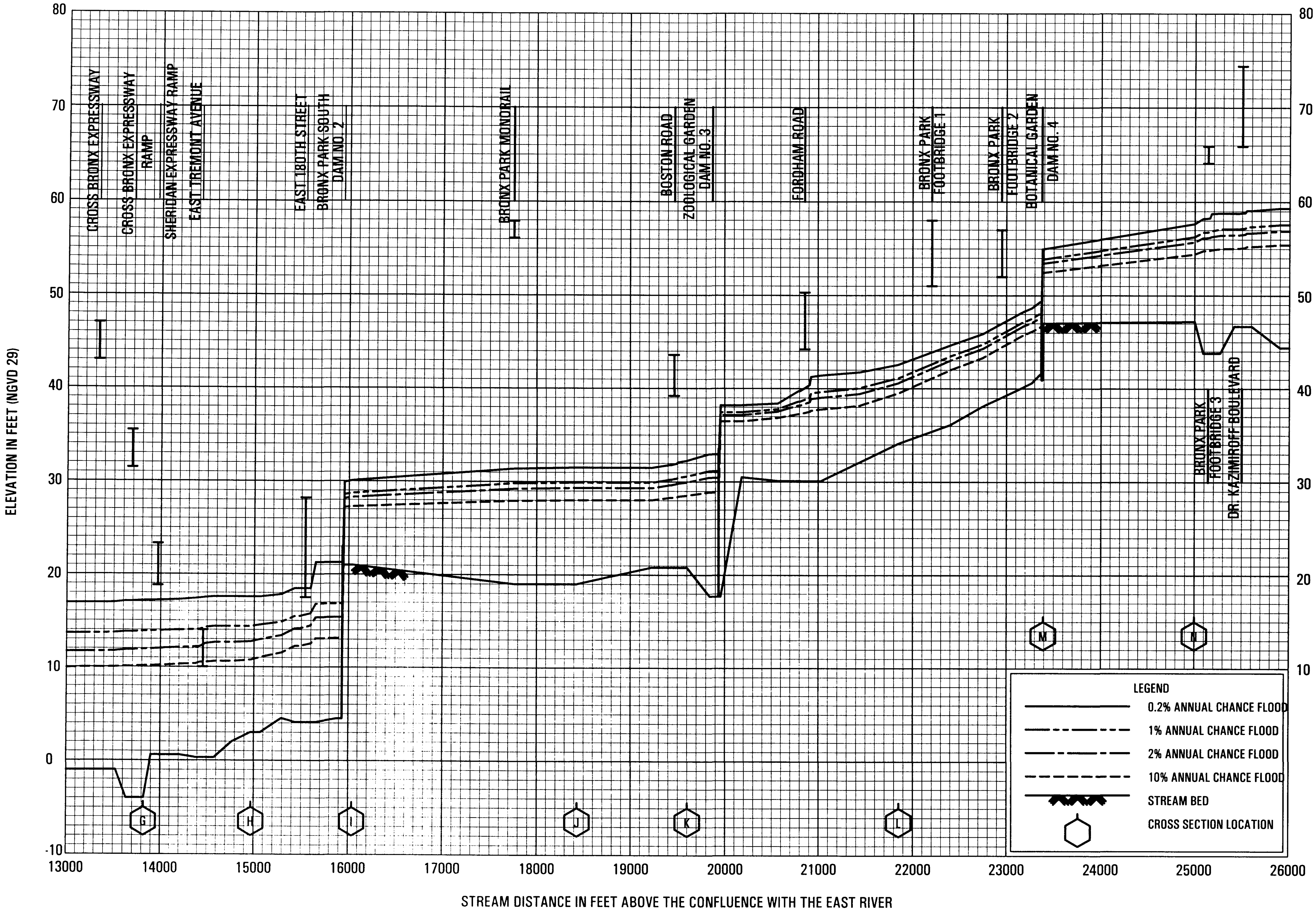
FLOOD PROFILES

BRONX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

06P



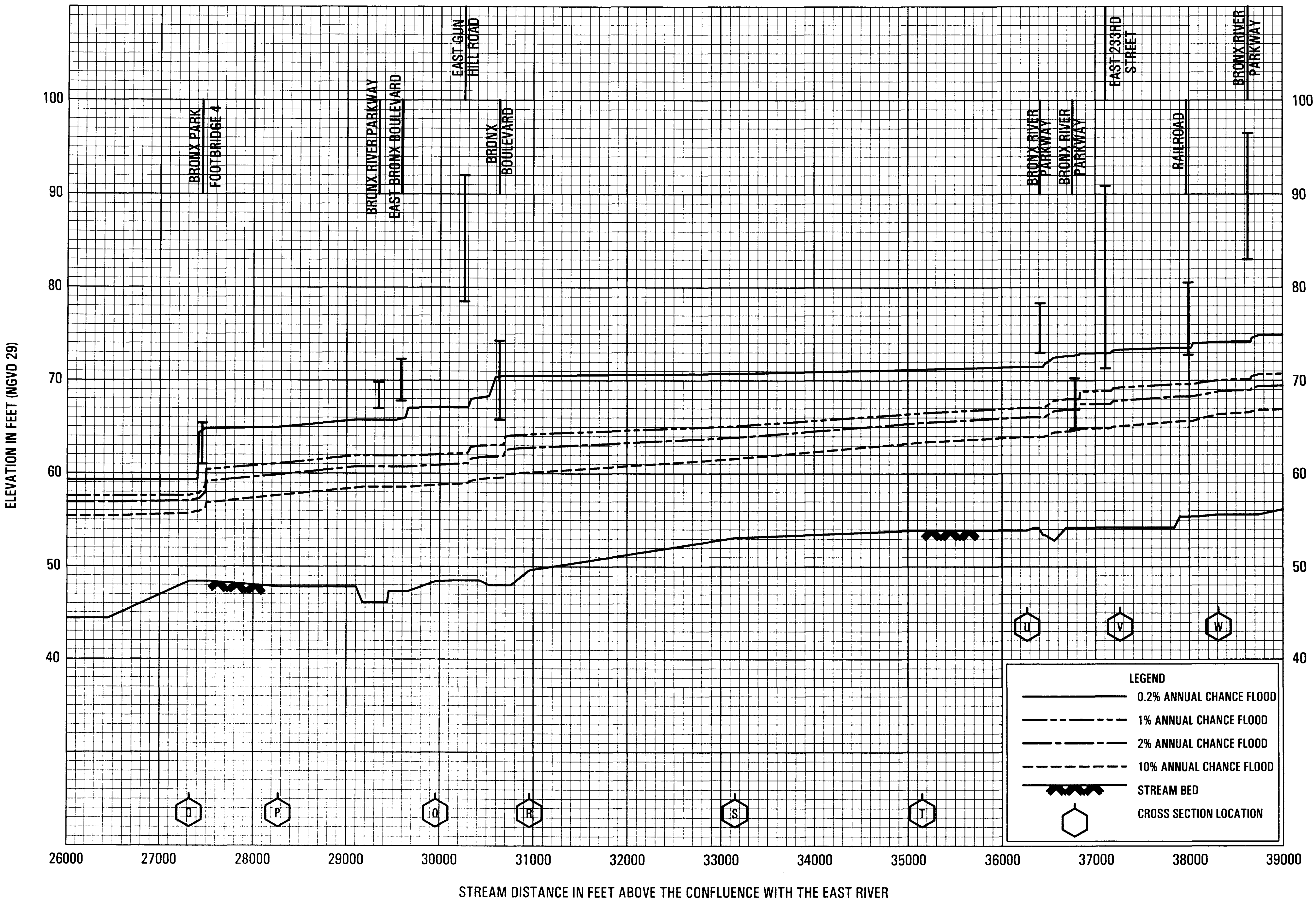
FLOOD PROFILES

BRONX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

07P

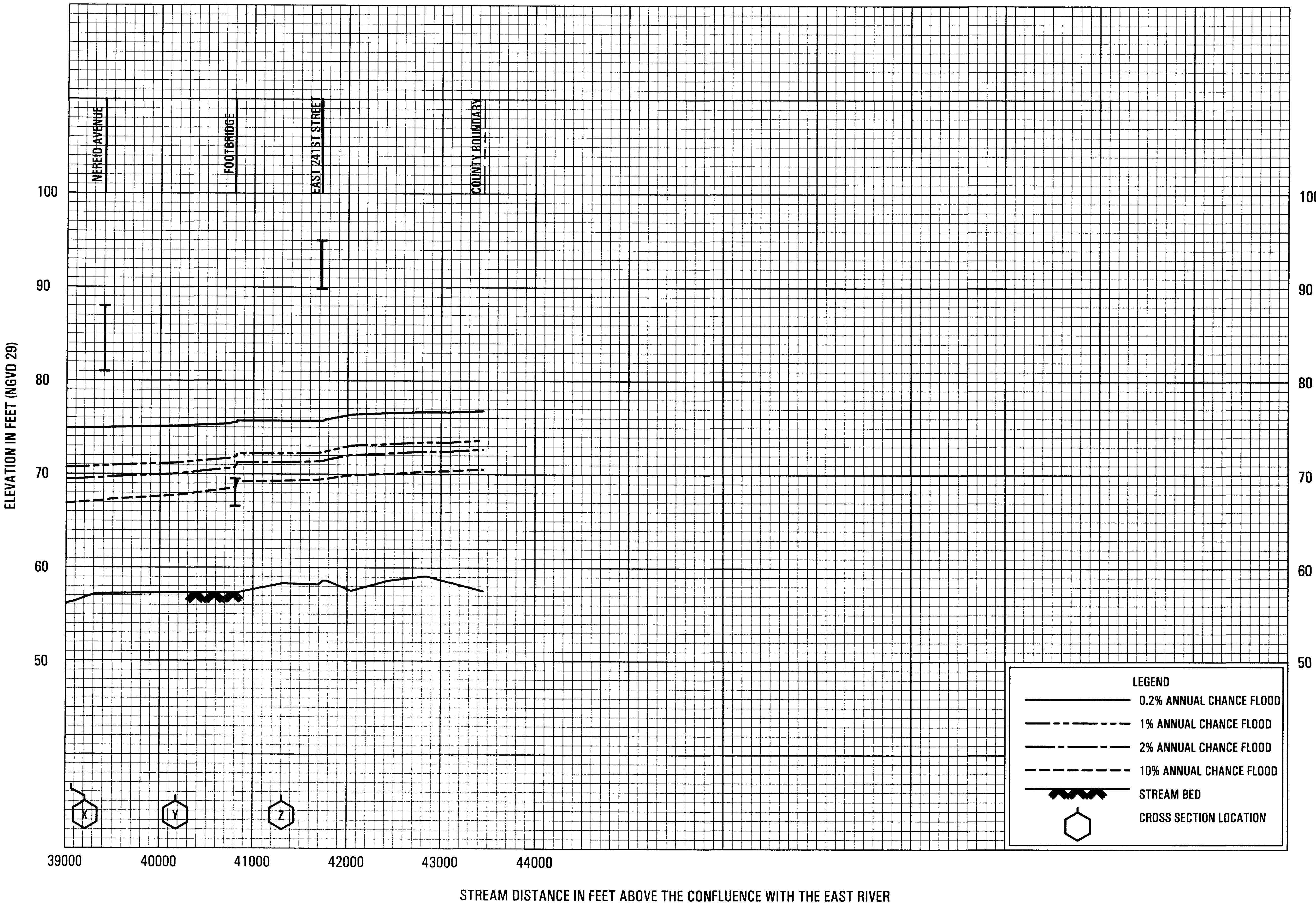


FLOOD PROFILES

BRONX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



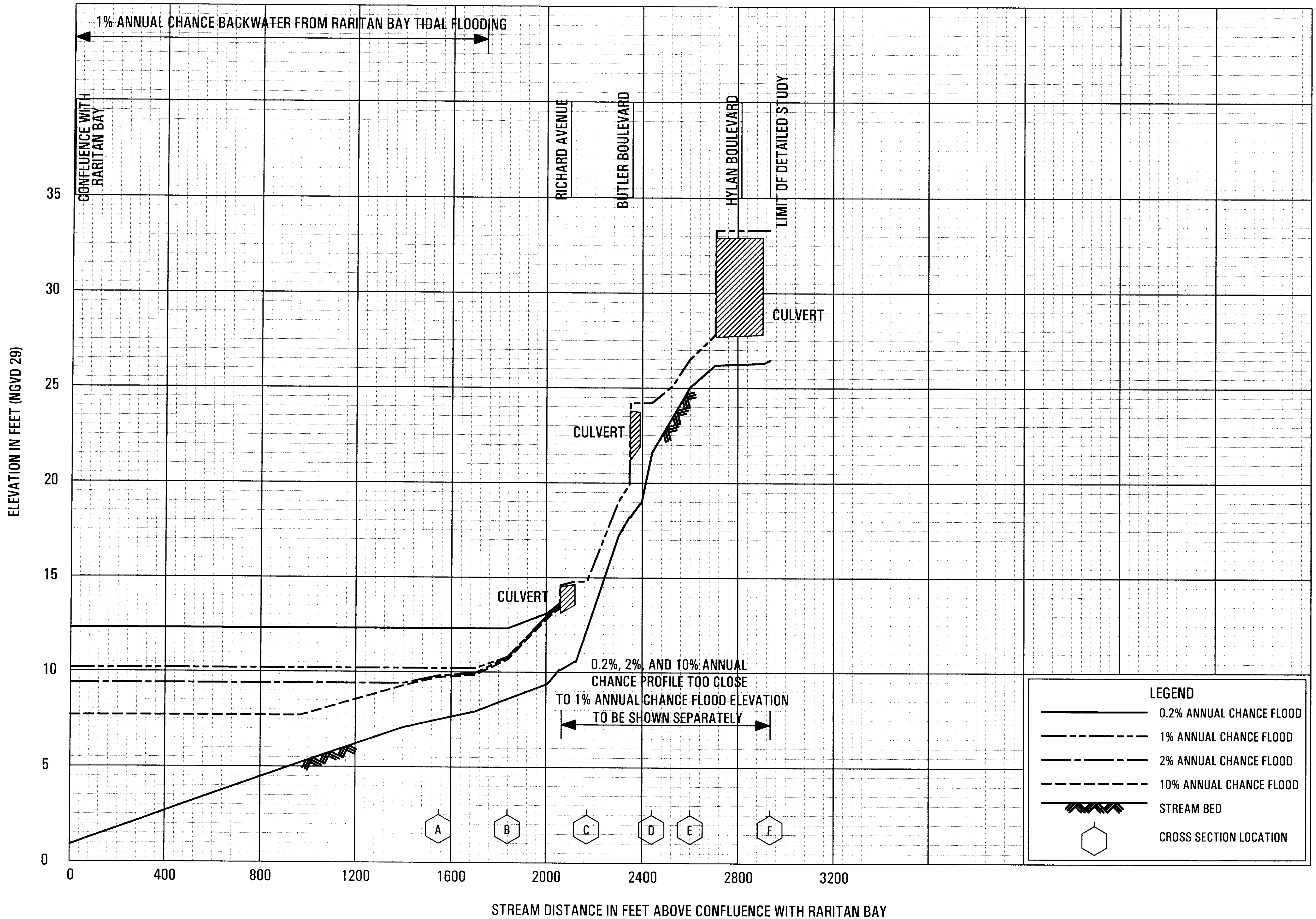
FLOOD PROFILES

BRONX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

09P



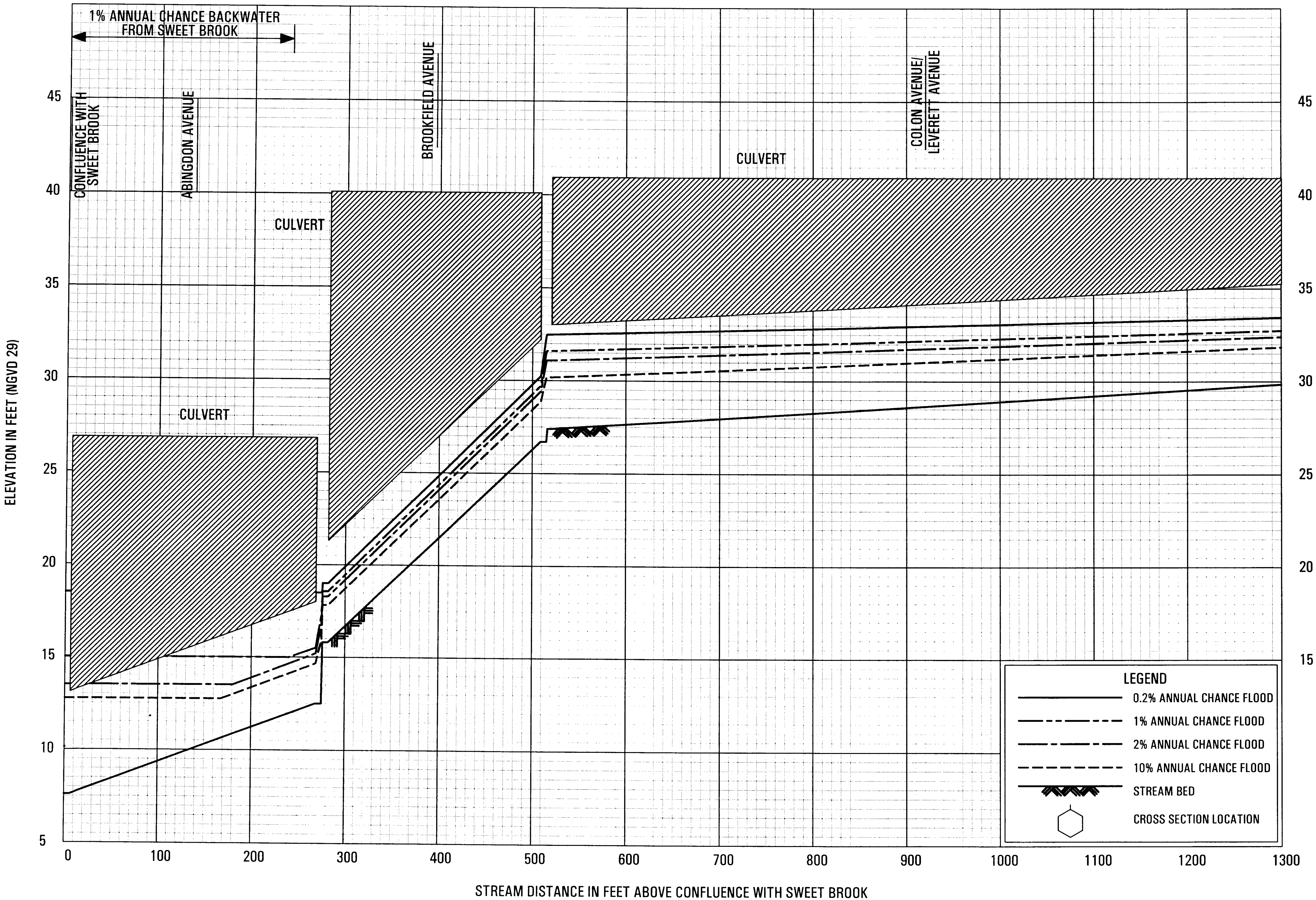
FLOOD PROFILES

BUTLER MANOR

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

10P



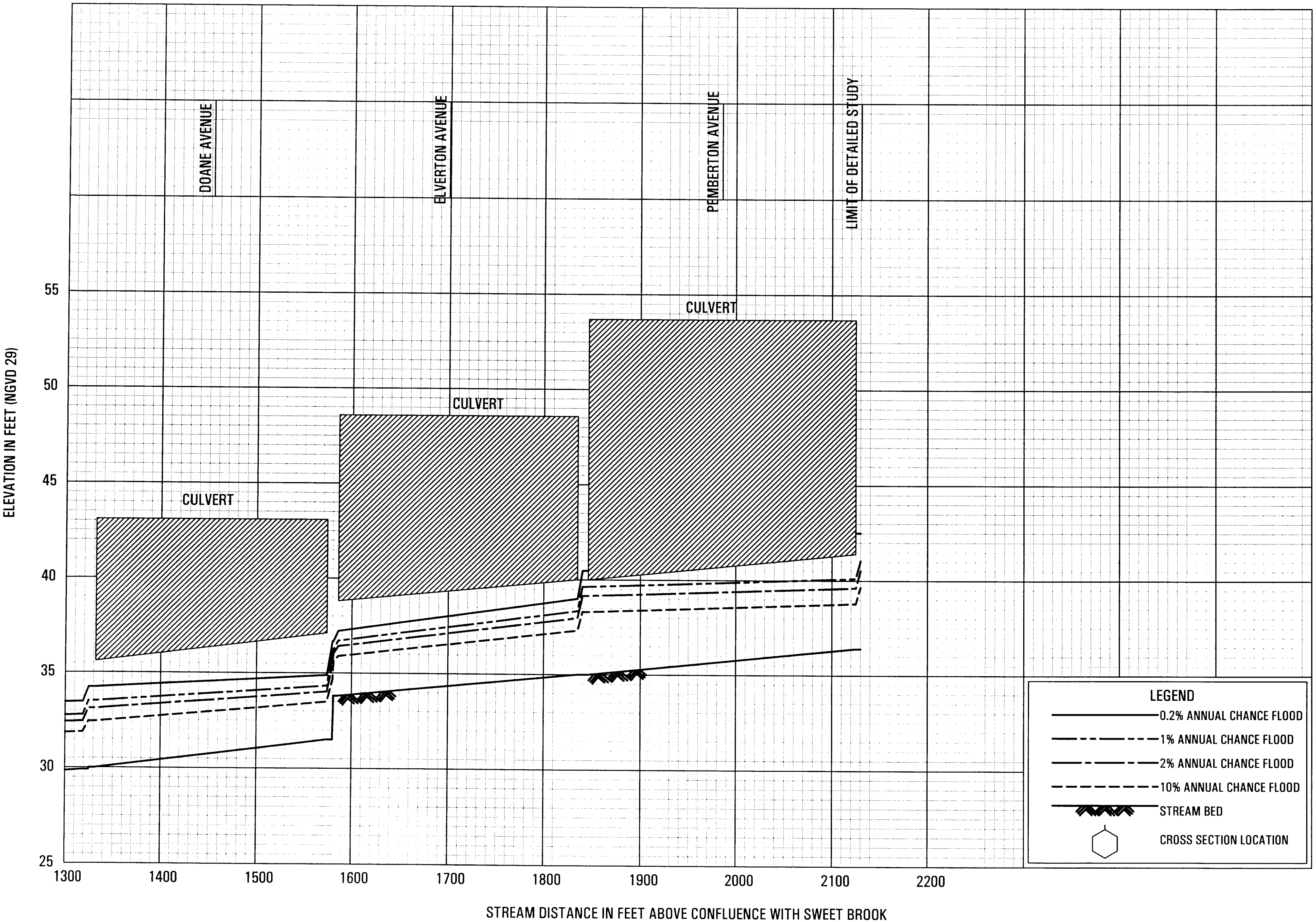
FLOOD PROFILES

COLON TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

11P



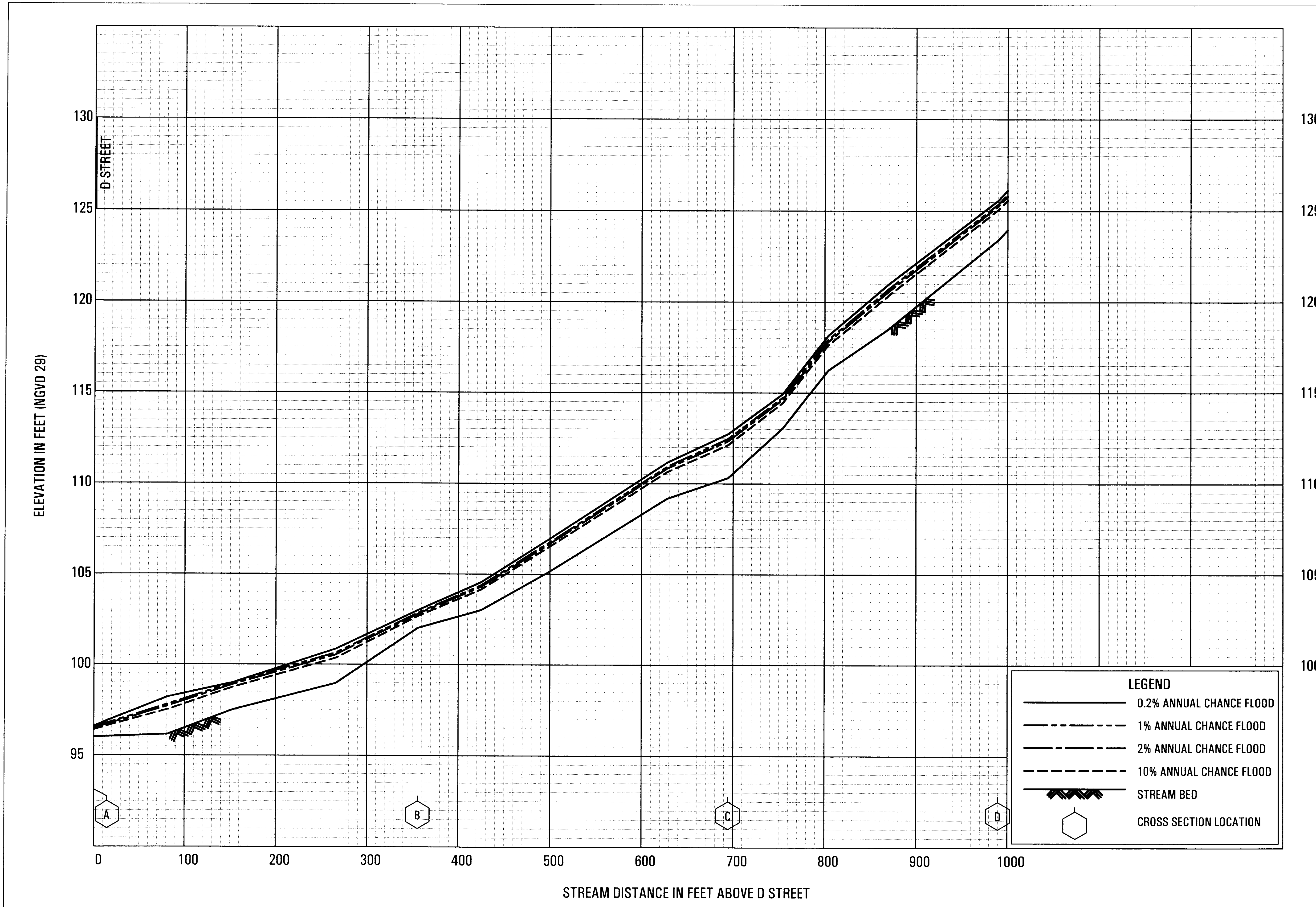
FLOOD PROFILES

COLON TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

12P



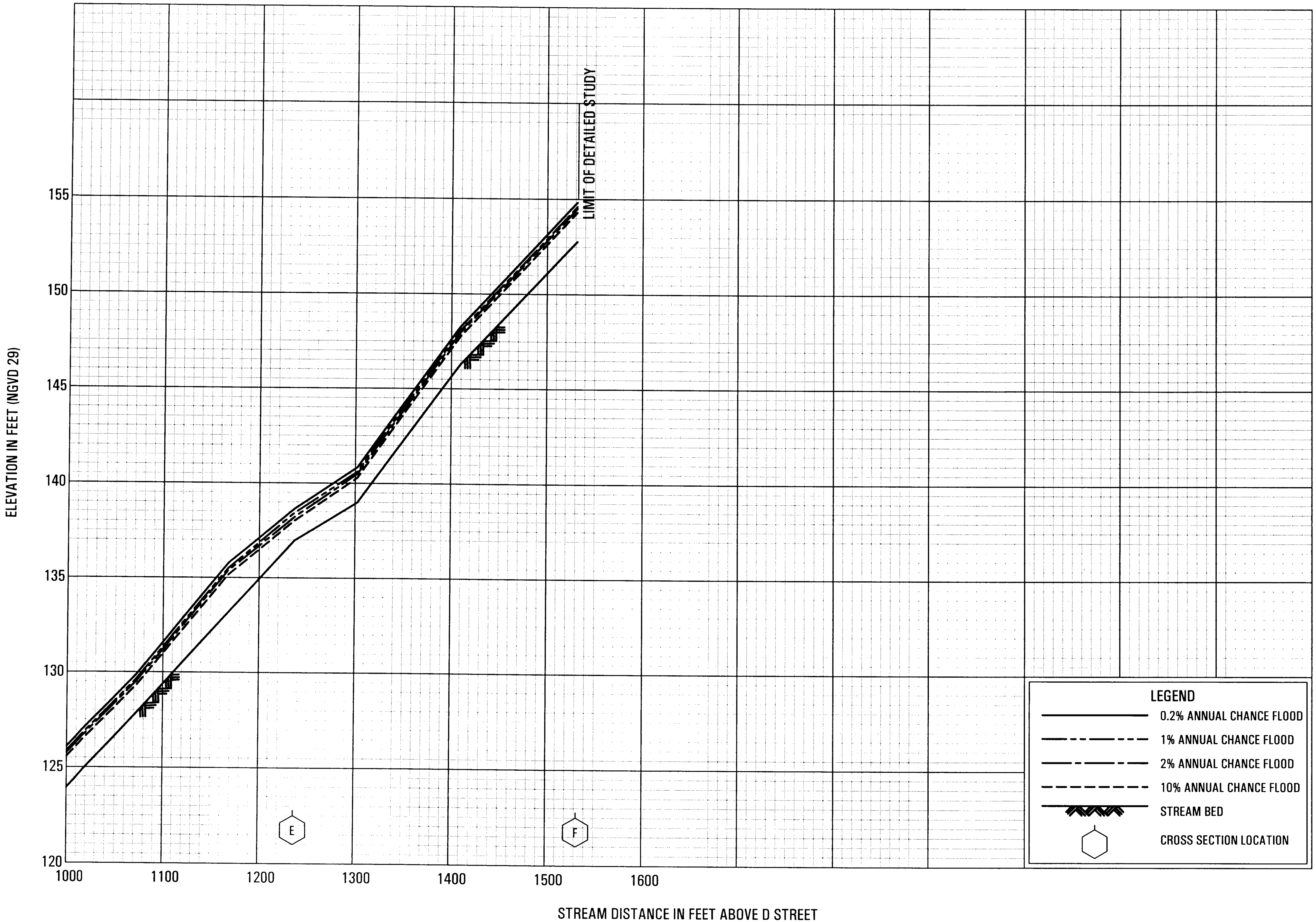
FLOOD PROFILES

D STREET BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

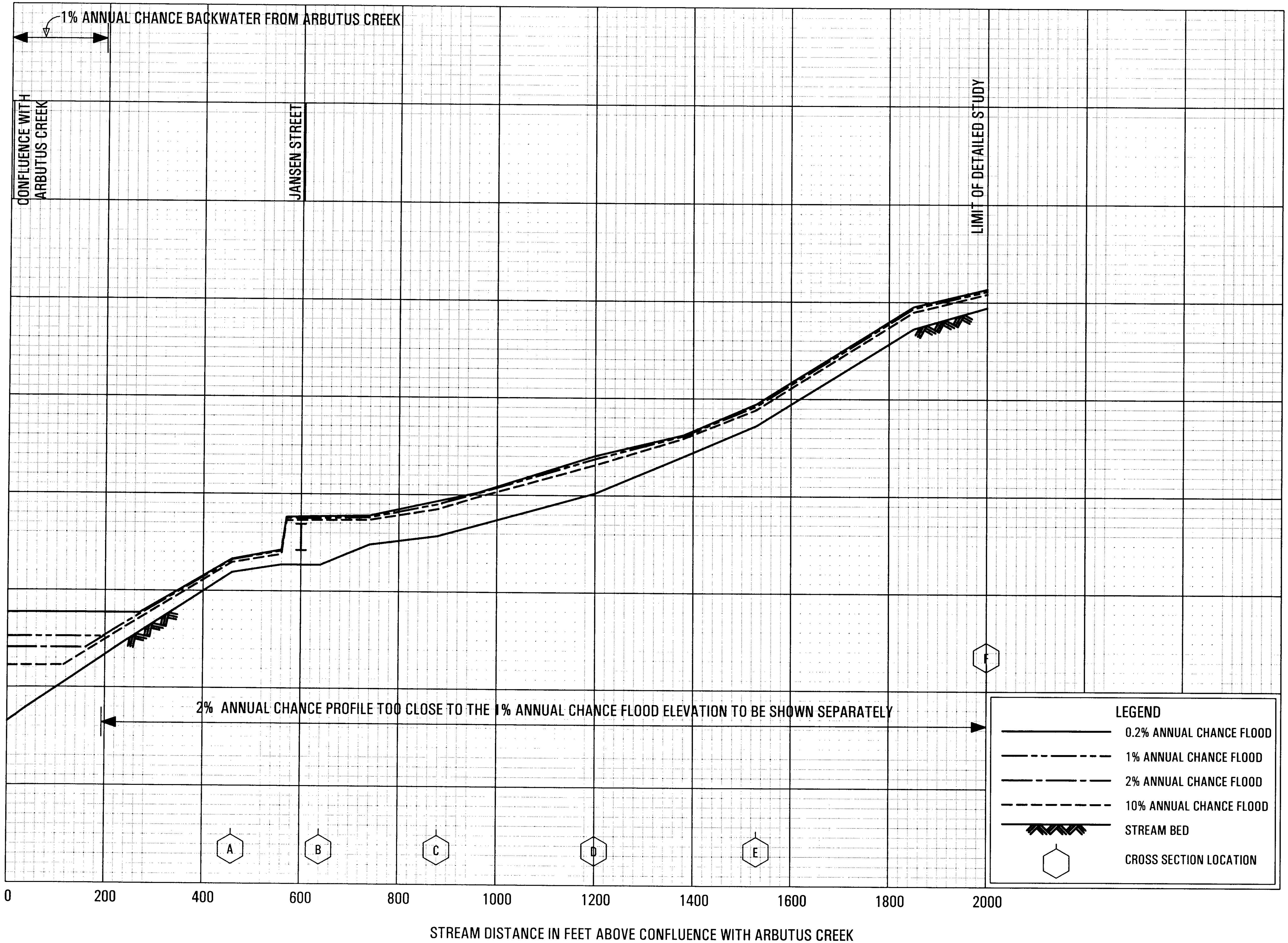
CITY OF NEW YORK, NY

13P



FLOOD PROFILES
D STREET BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF NEW YORK, NY



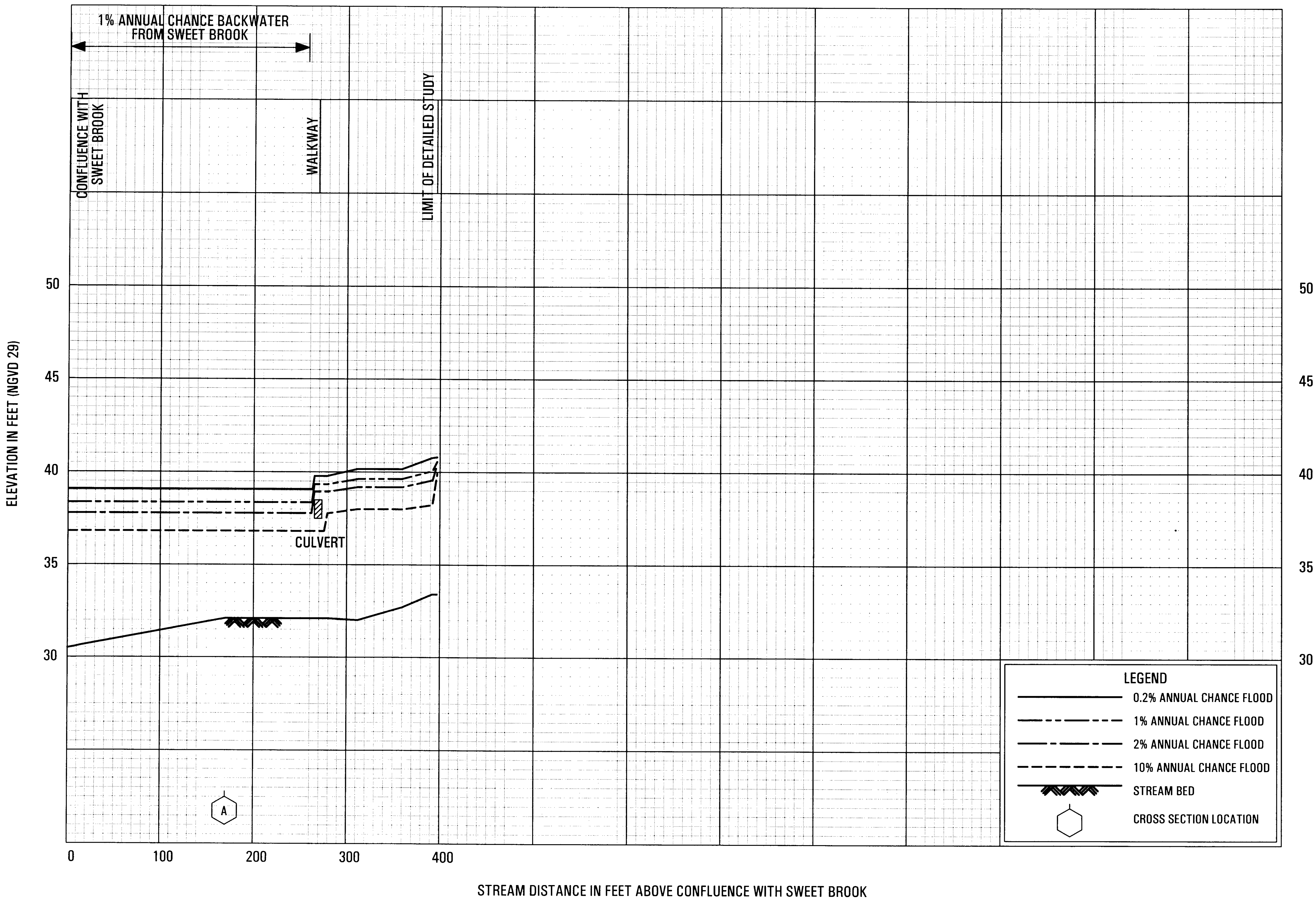
FLOOD PROFILES

DENISE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

15P

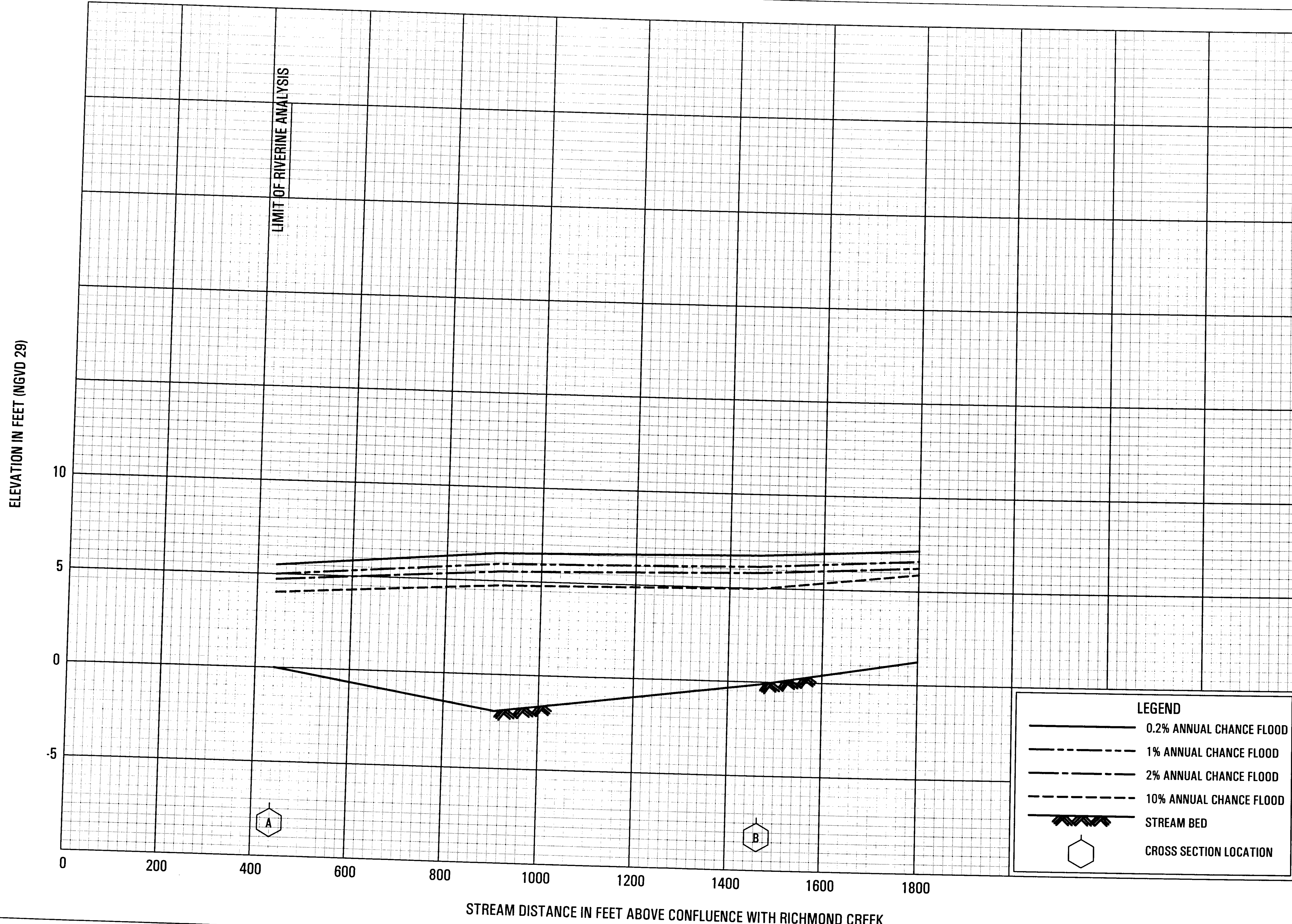


FLOOD PROFILES

ELTINGVILLE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

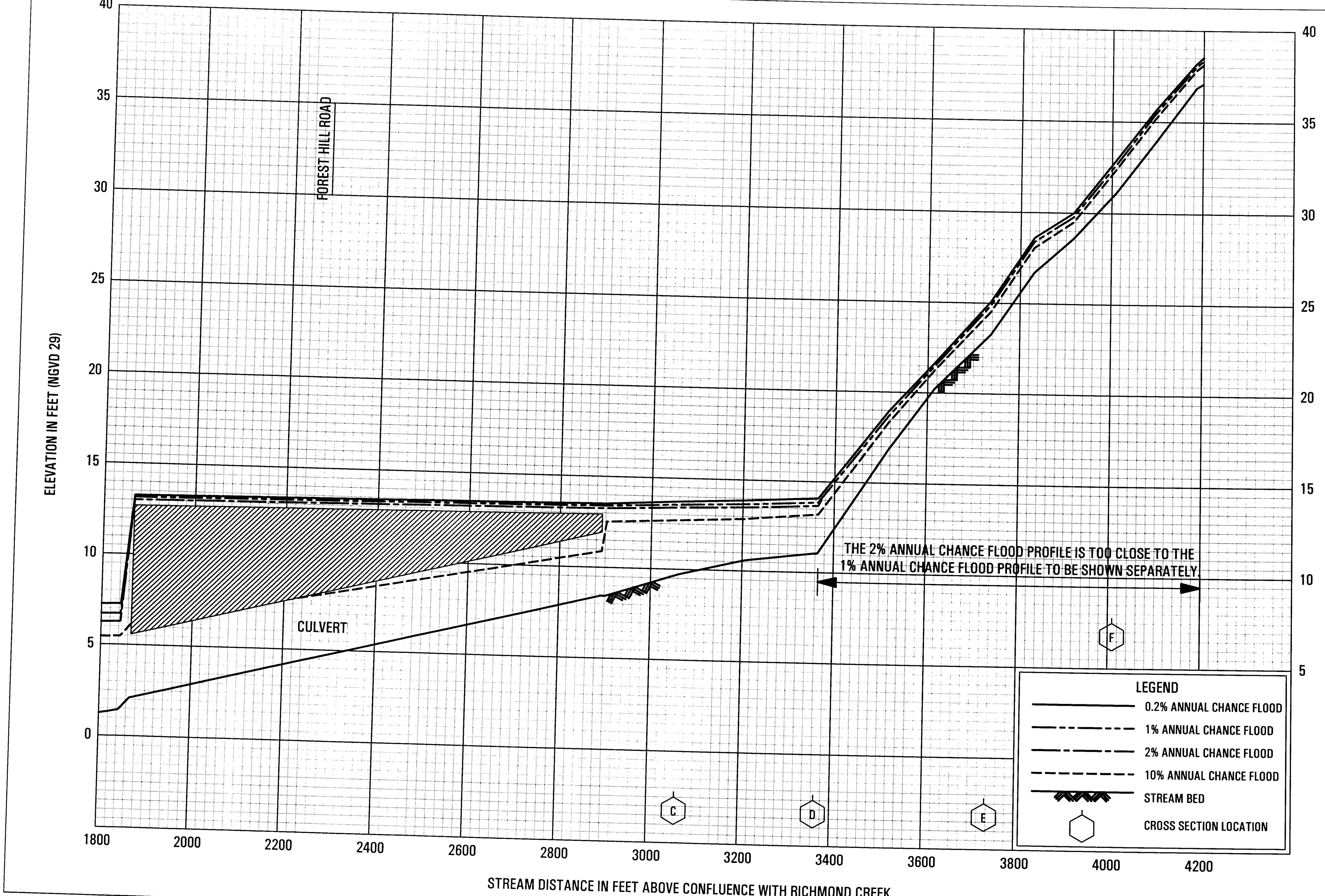


FLOOD PROFILES

FOREST HILL ROAD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

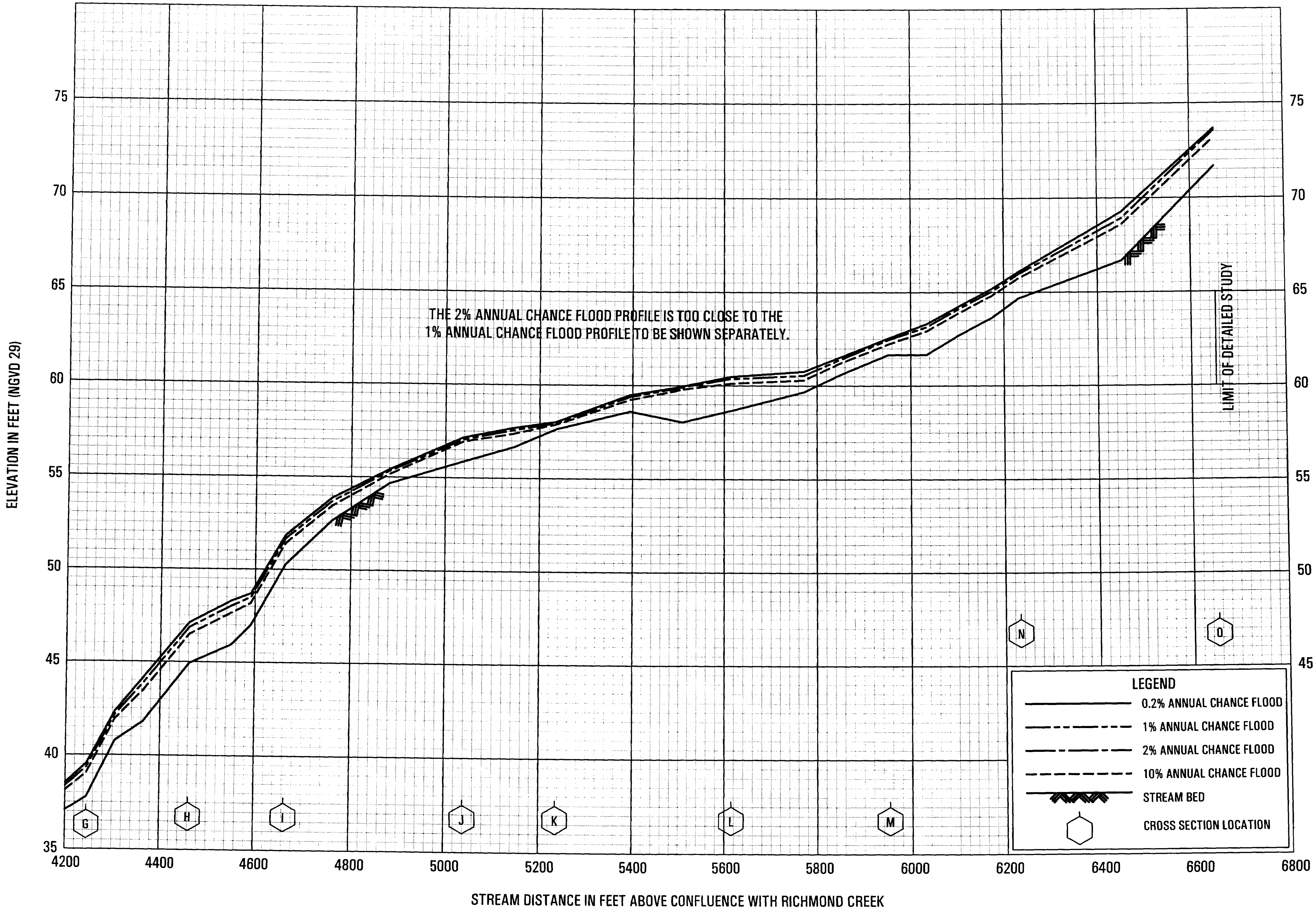


FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

FLOOD PROFILES

FOREST HILL ROAD BROOK



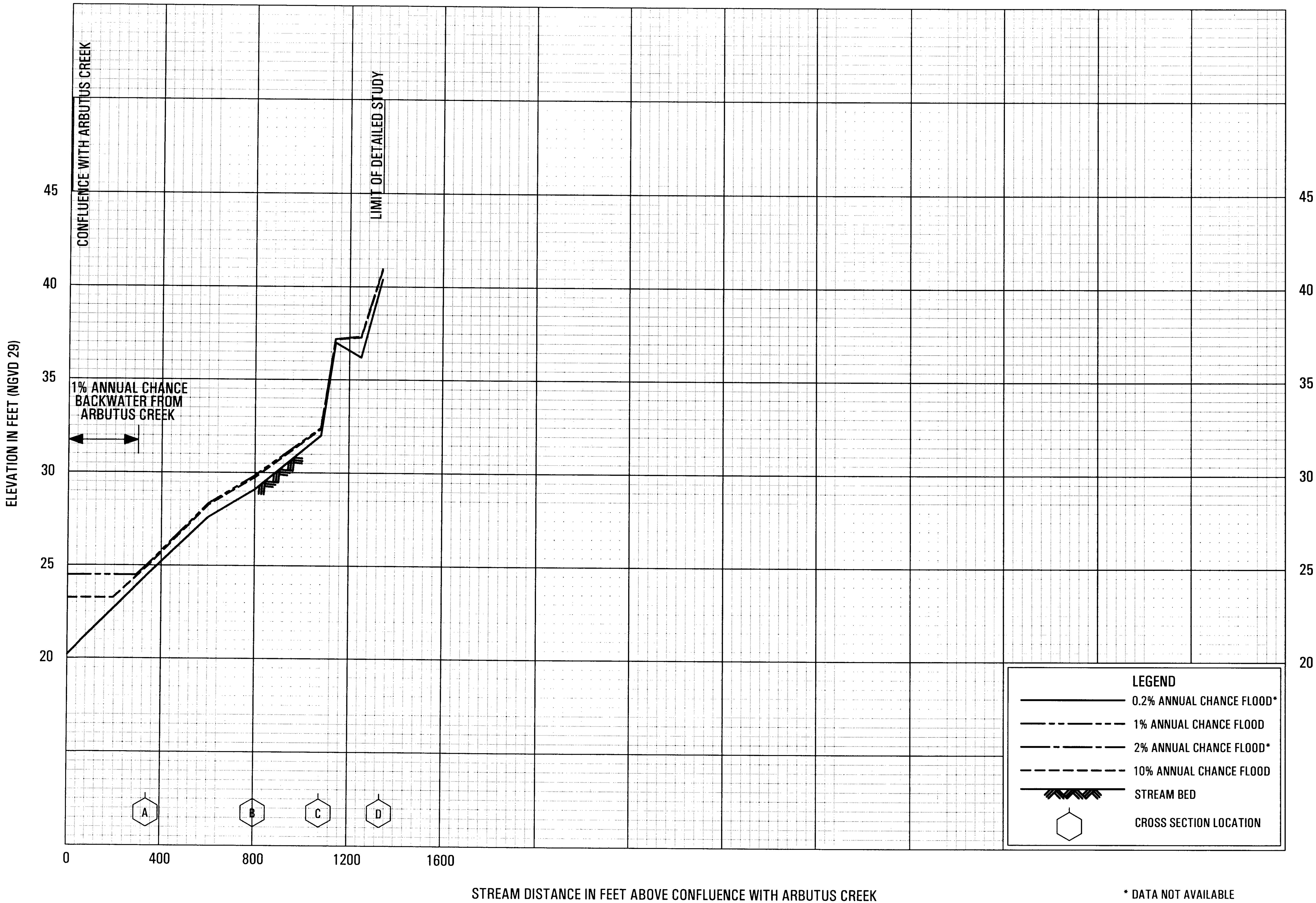
FLOOD PROFILES

FOREST HILL ROAD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

19P



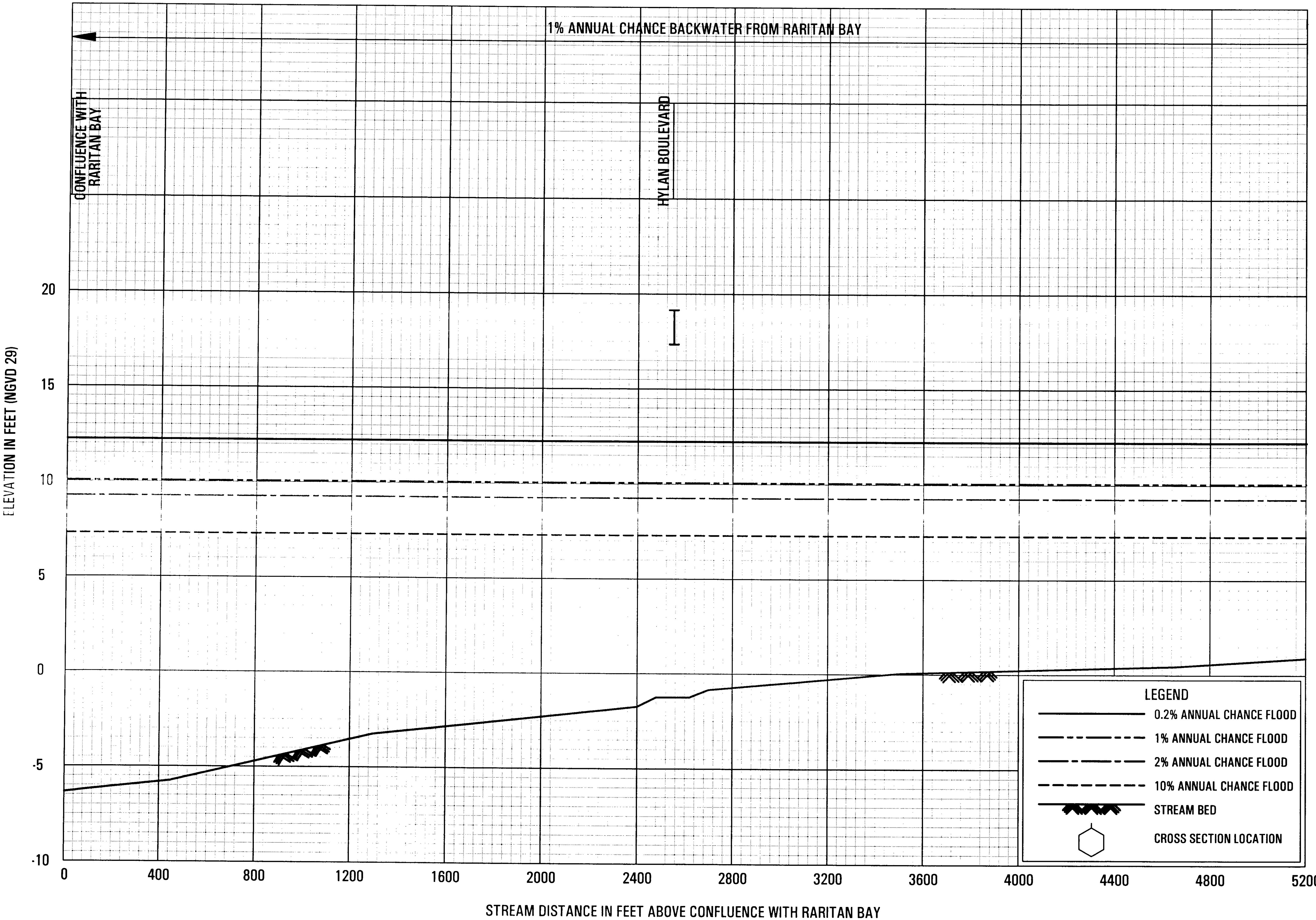
FLOOD PROFILES

JANSEN TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

20P

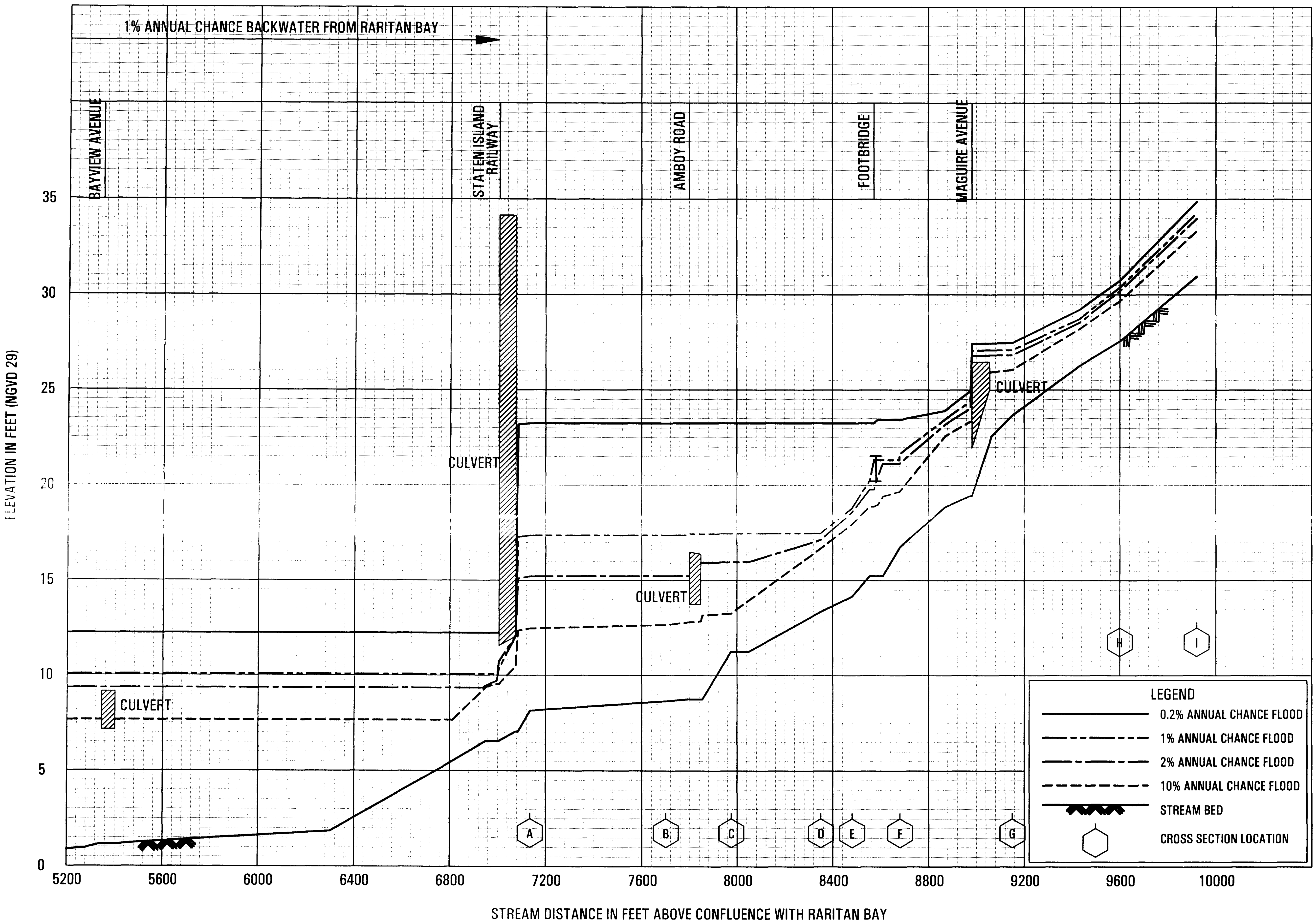


FLOOD PROFILES

LEMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

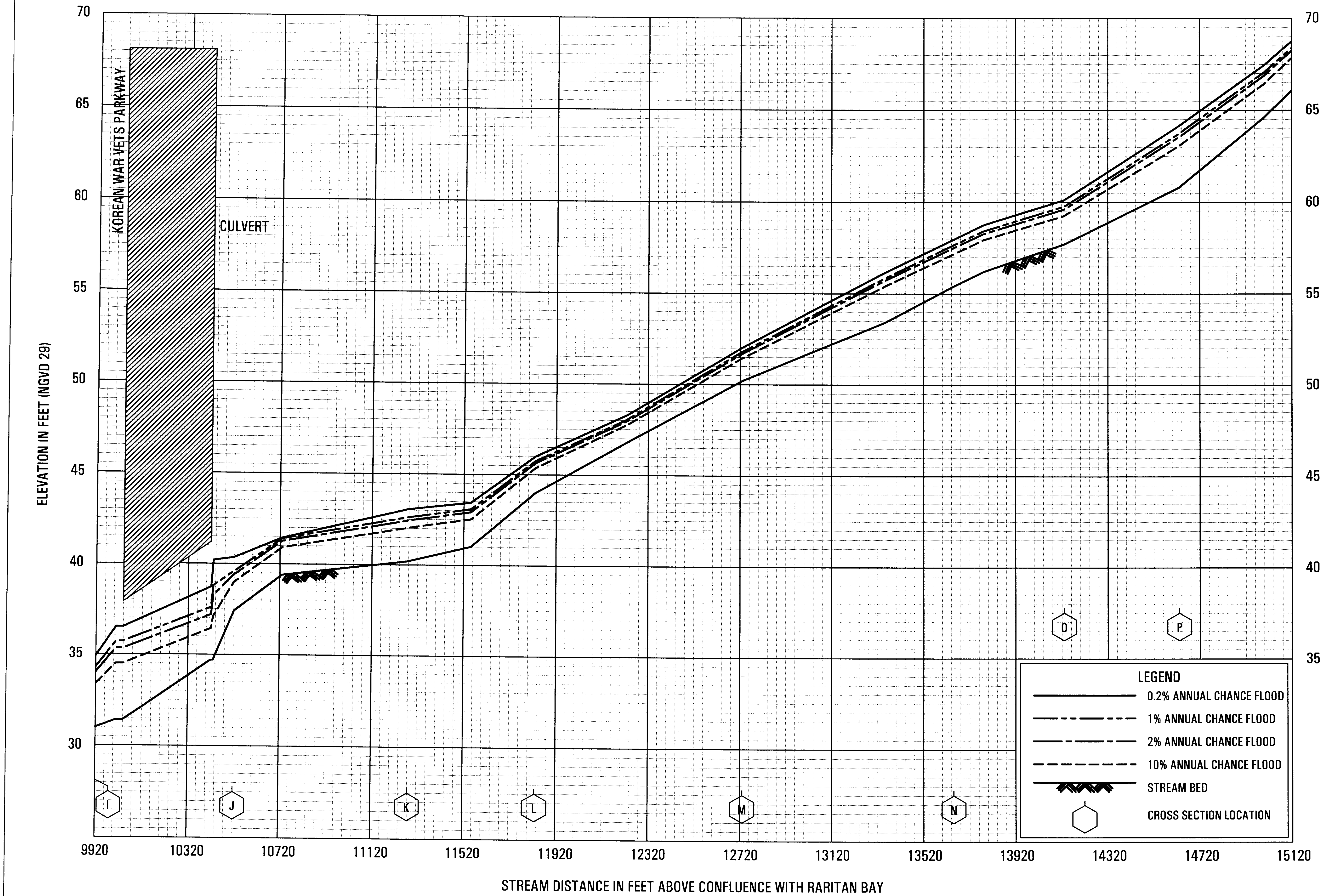


FLOOD PROFILES

LEMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



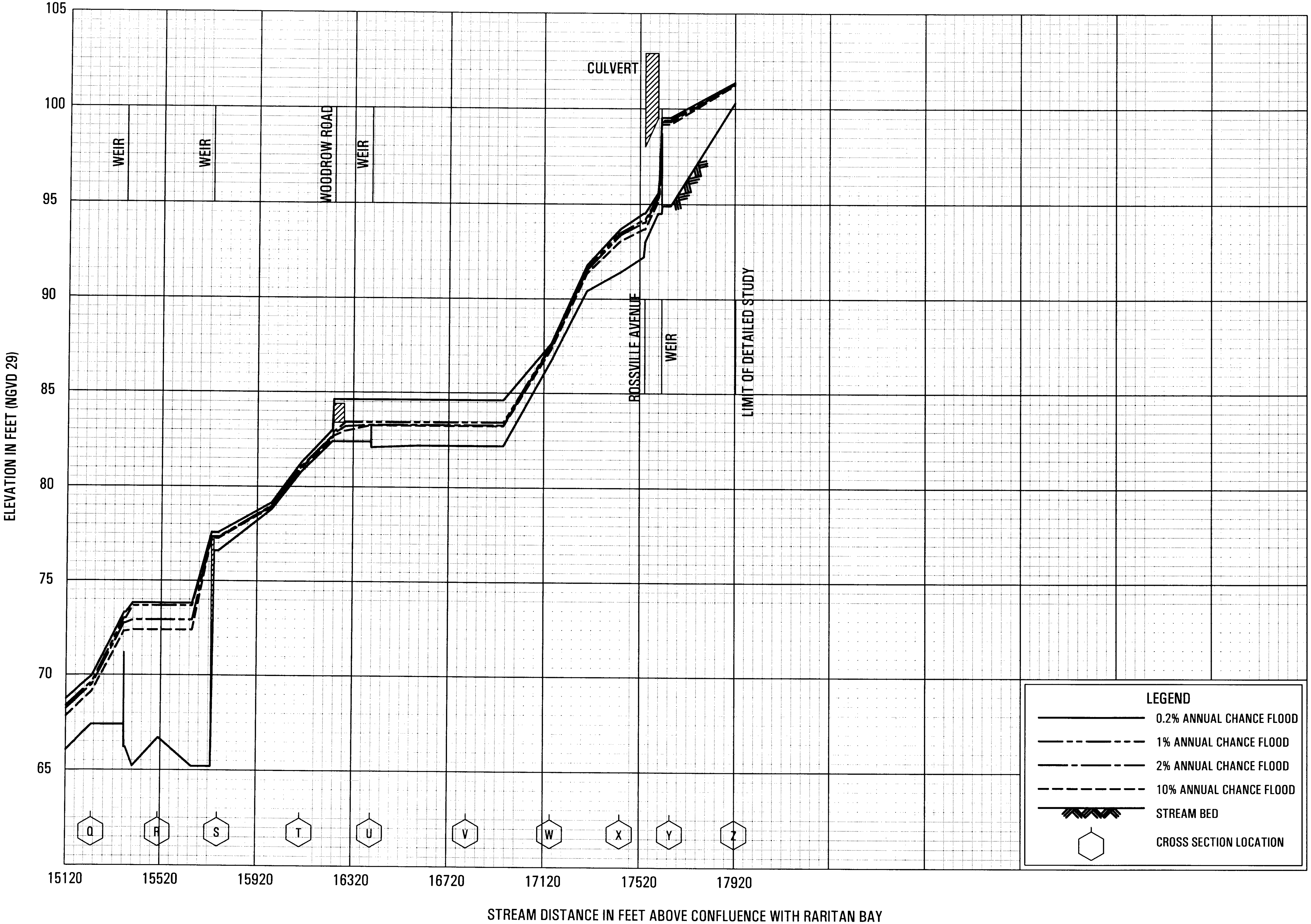
FLOOD PROFILES

LEMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

23P



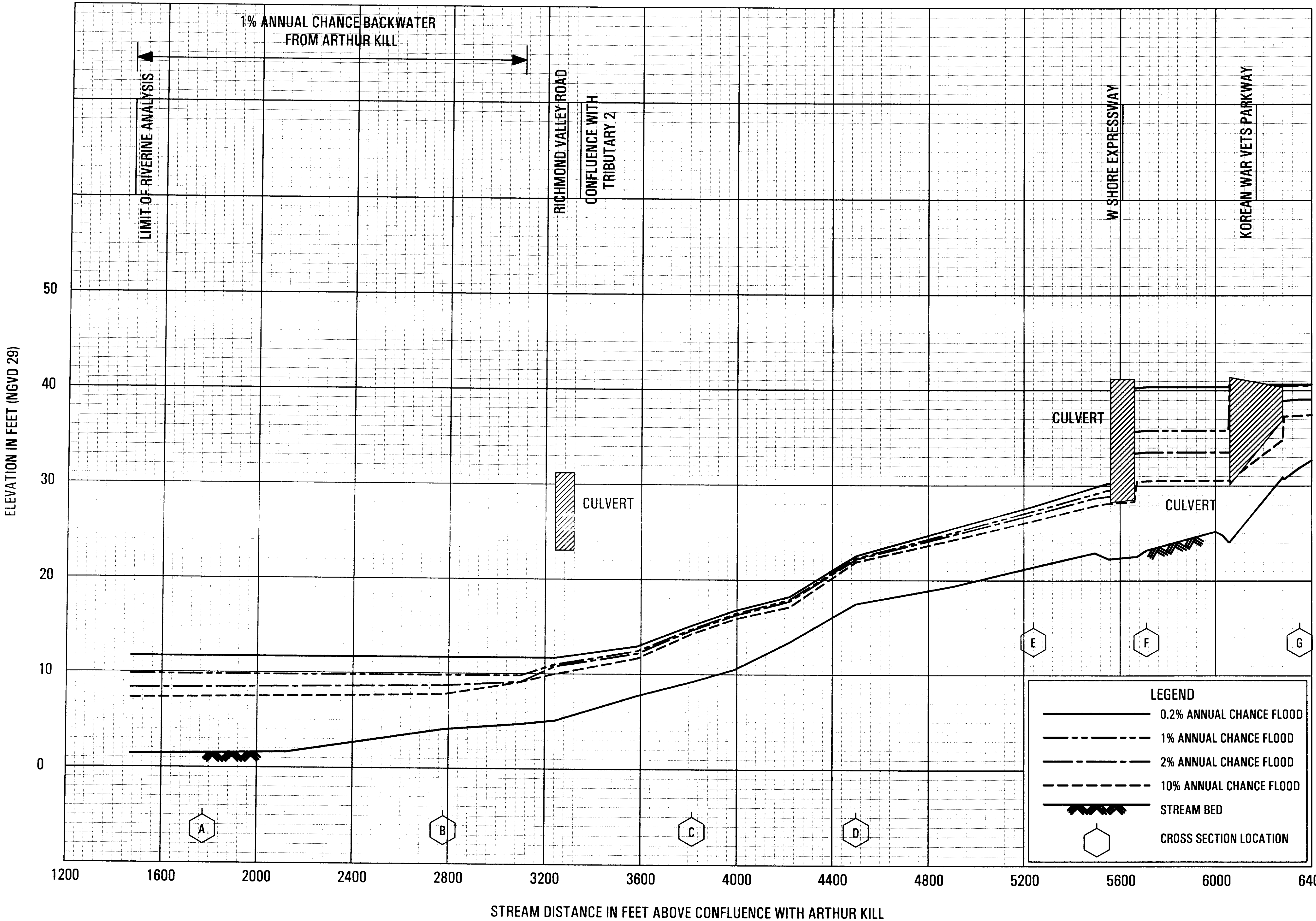
FLOOD PROFILES

LEMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

24P

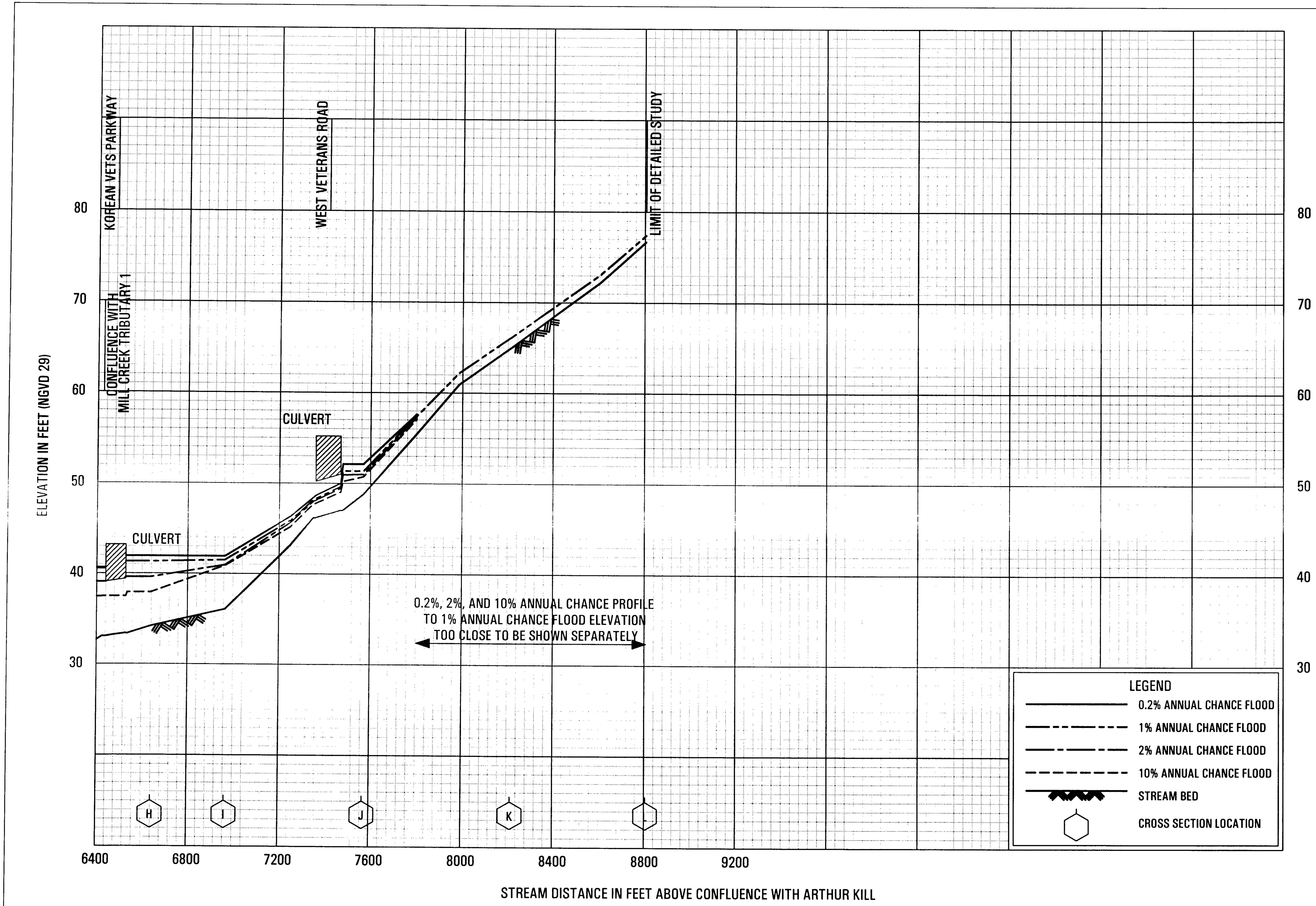


FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



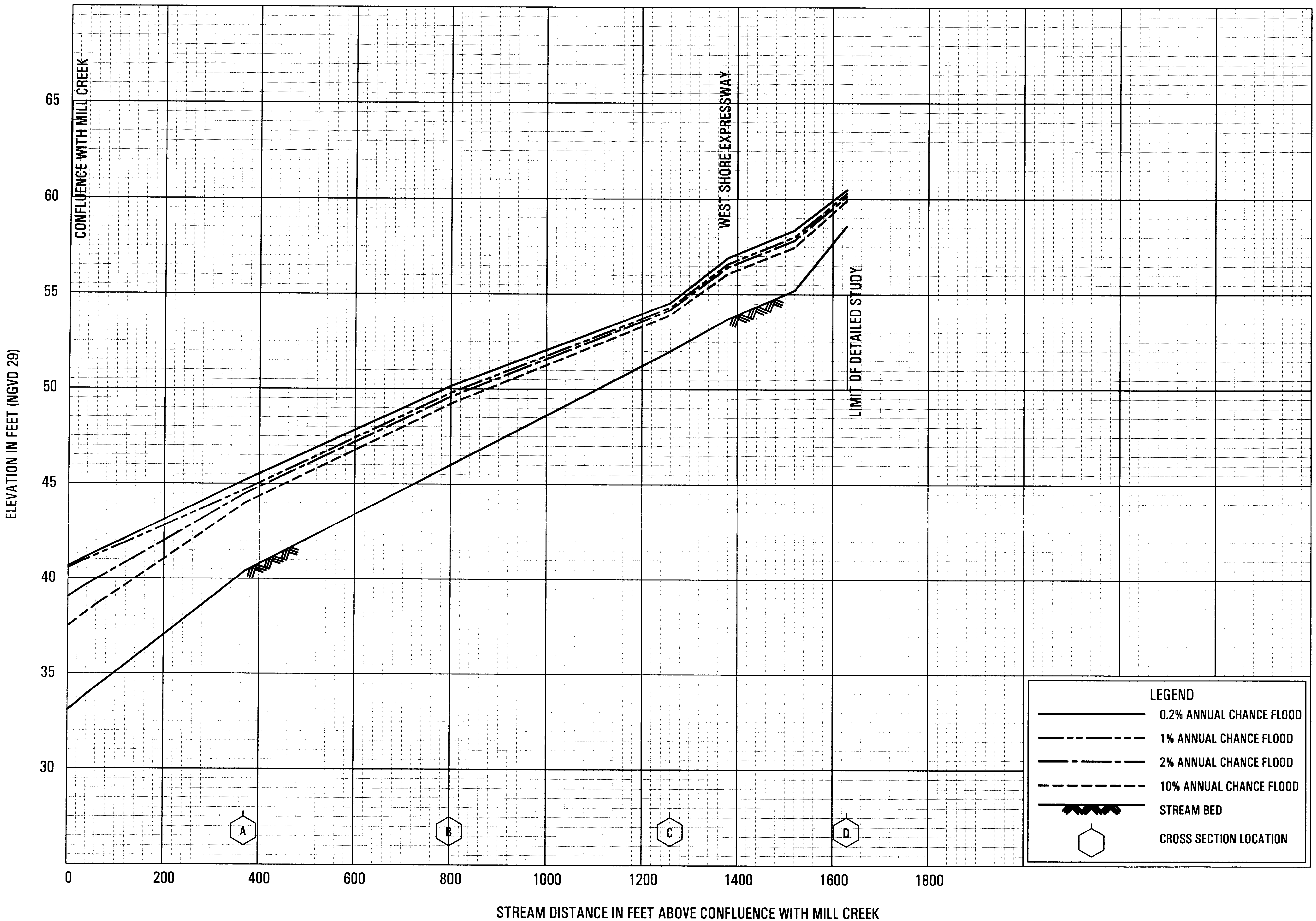
FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

26P

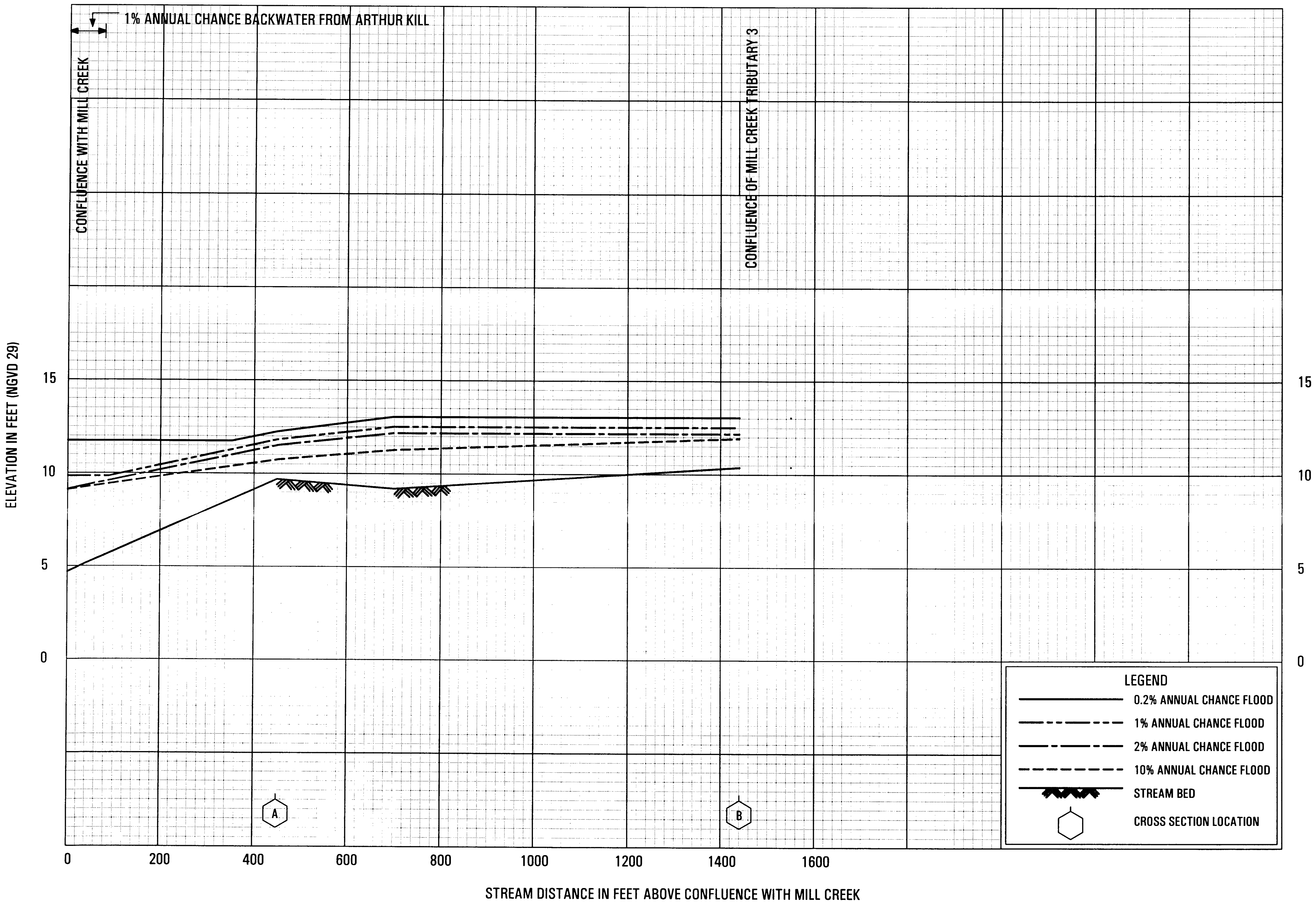


FLOOD PROFILES

MILL CREEK TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



FLOOD PROFILES

MILL CREEK TRIBUTARY 2

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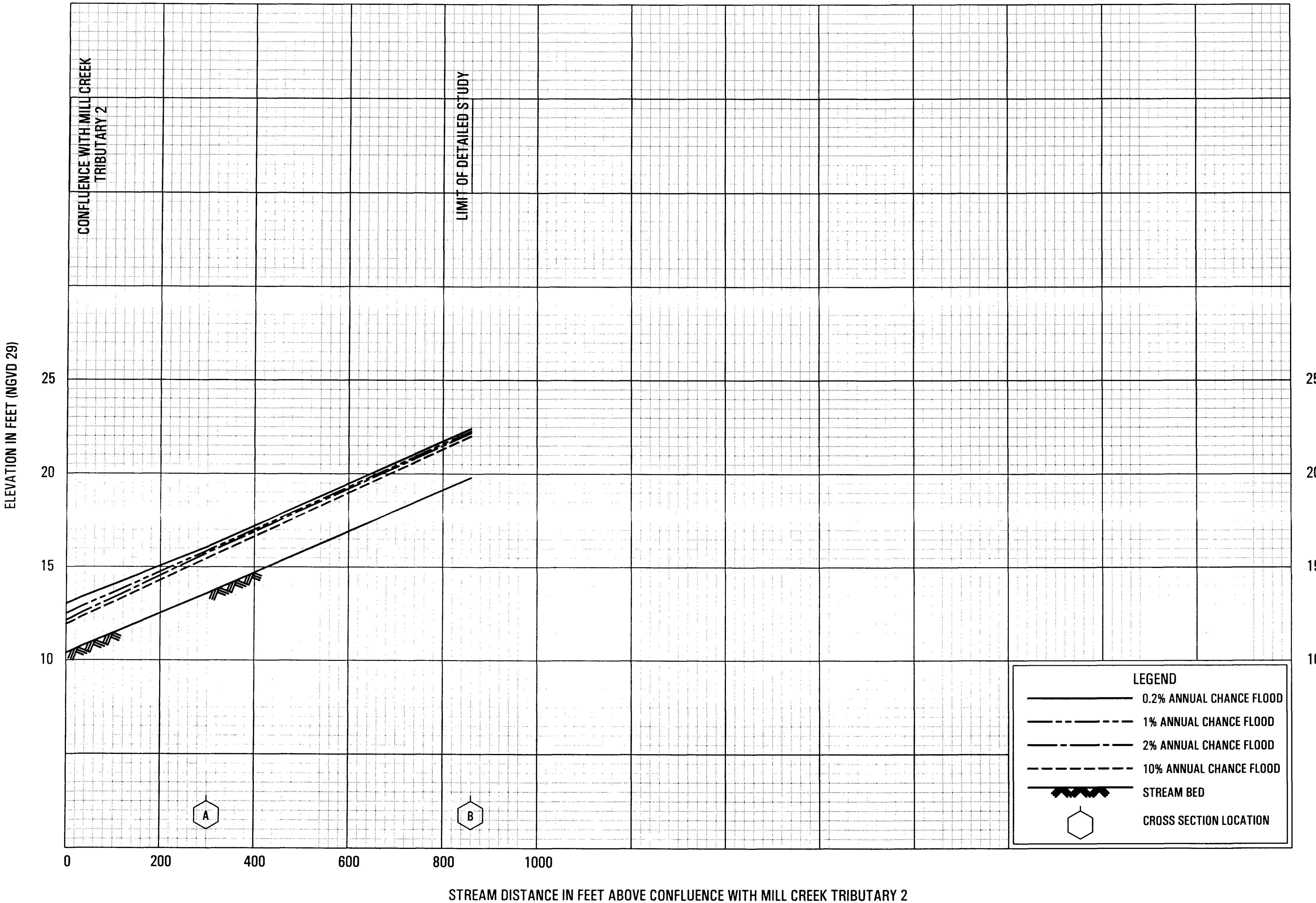
CITY OF NEW YORK, NY

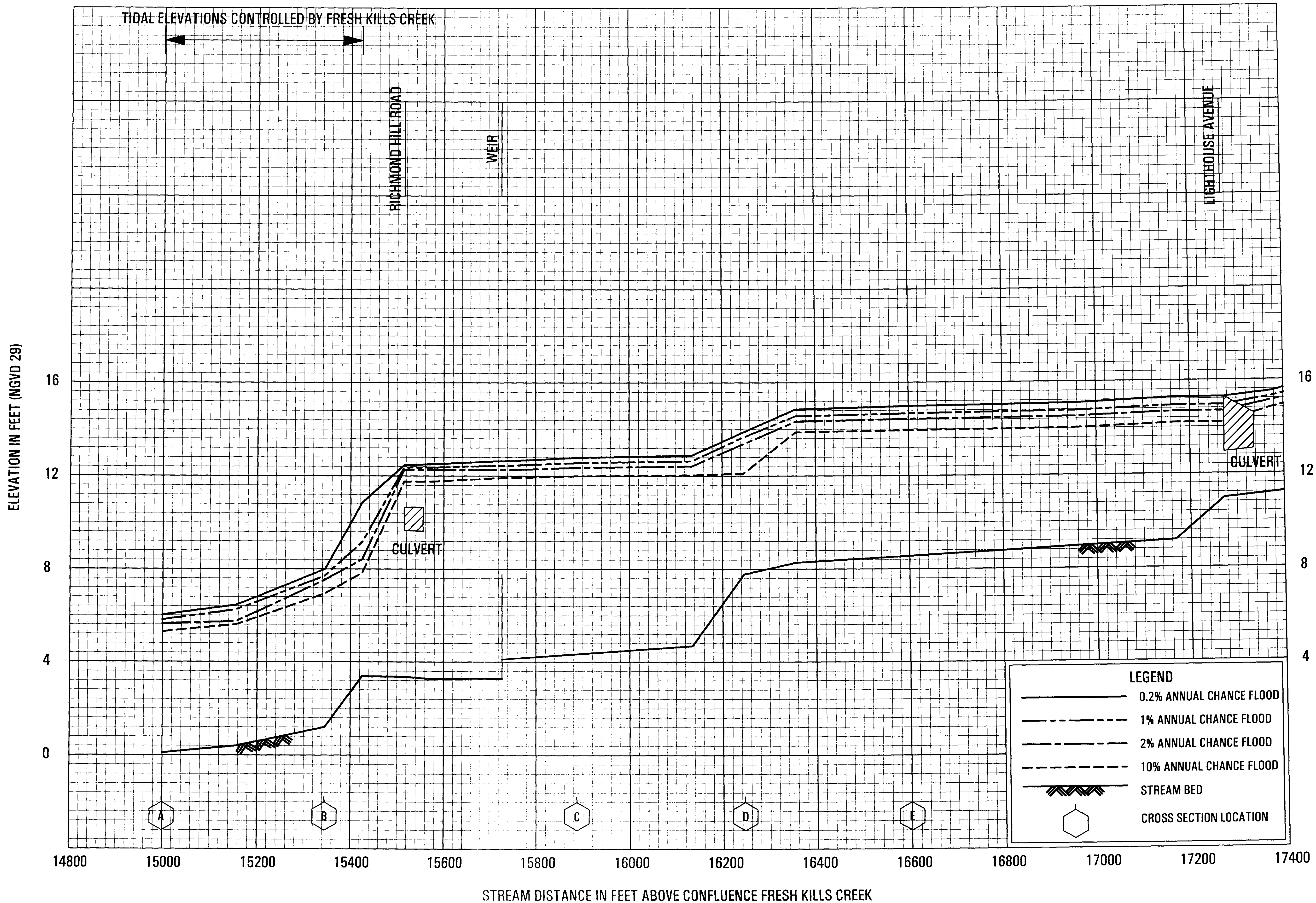


FLOOD PROFILES

MILL CREEK TRIBUTARY 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

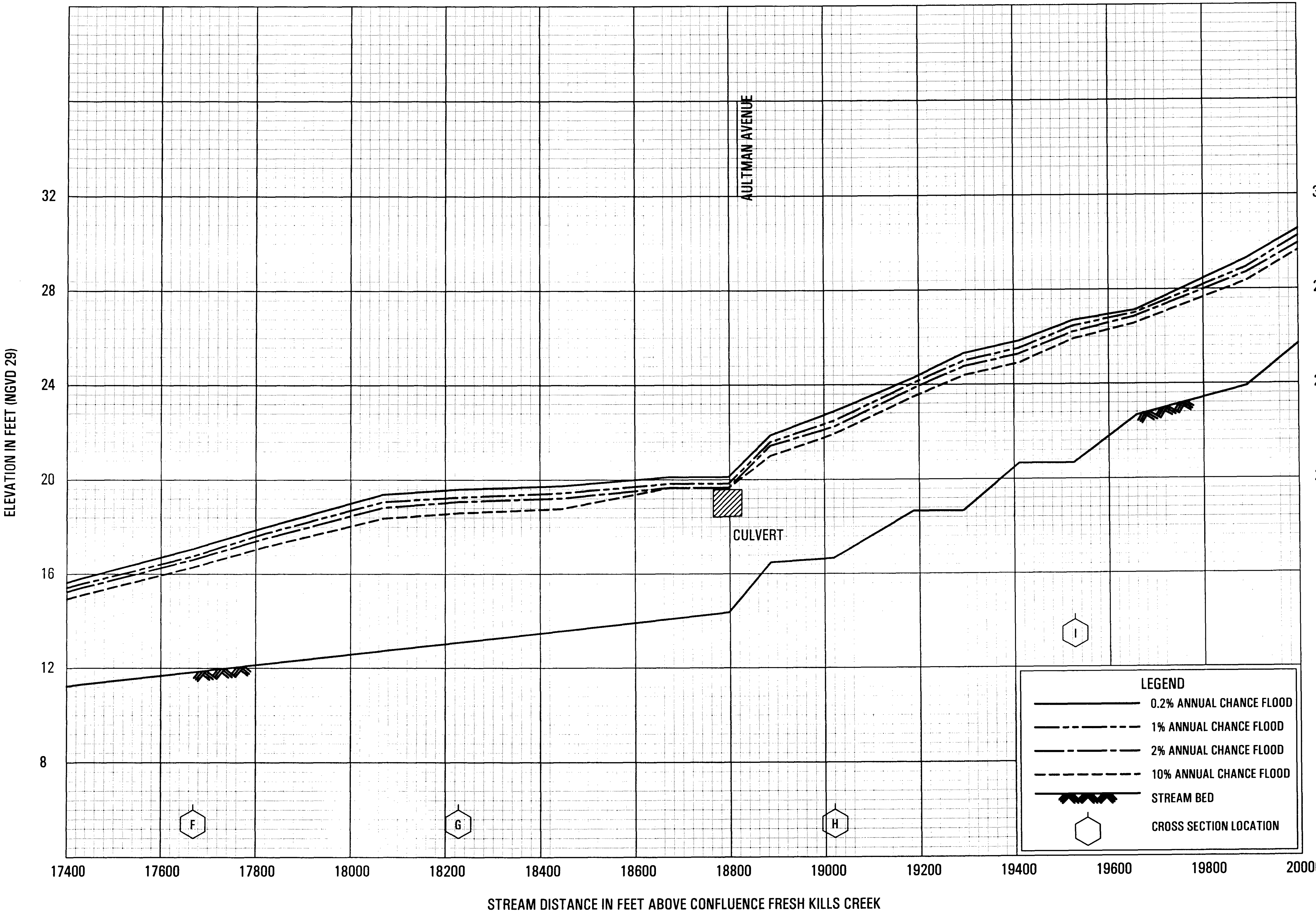


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

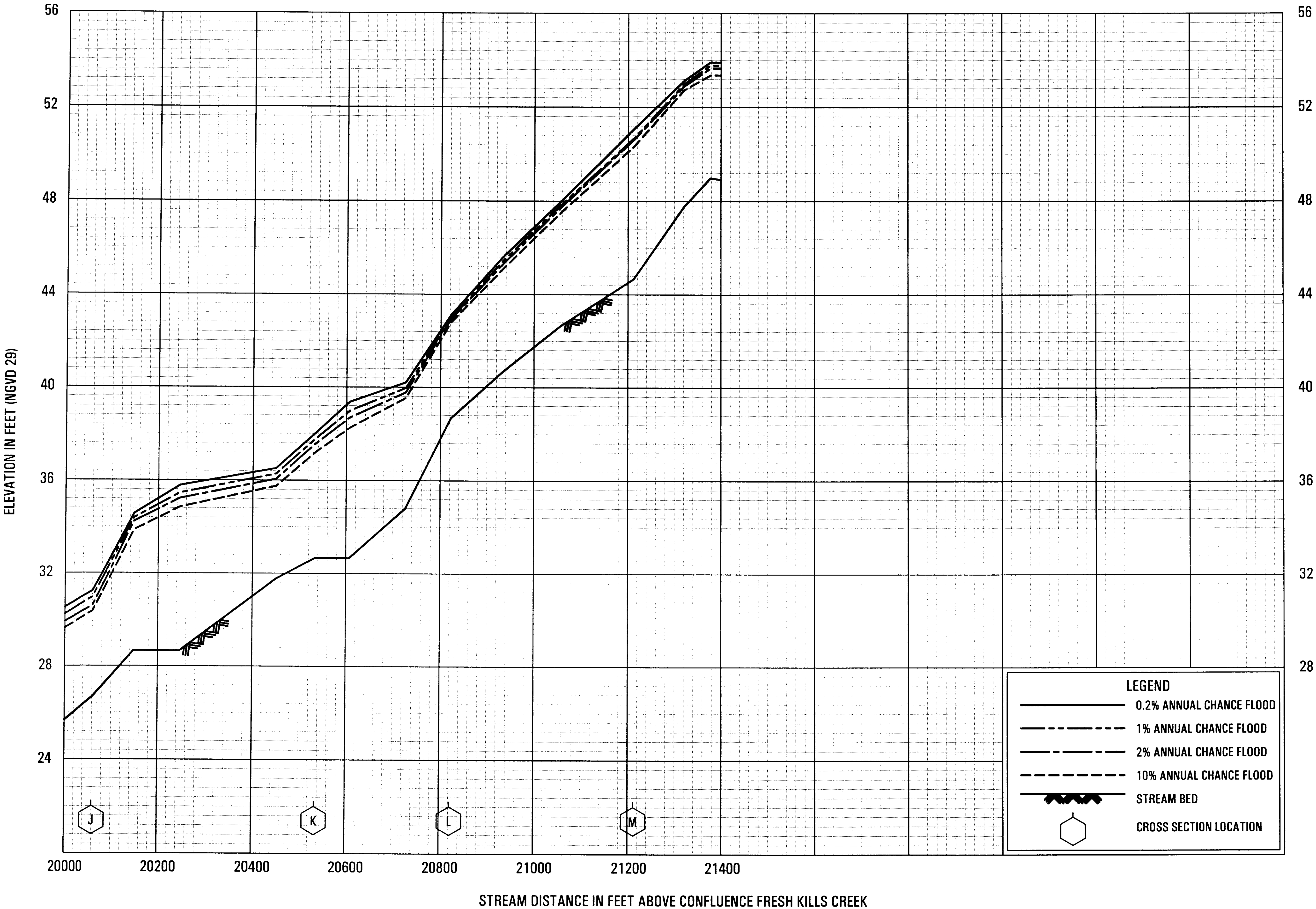


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

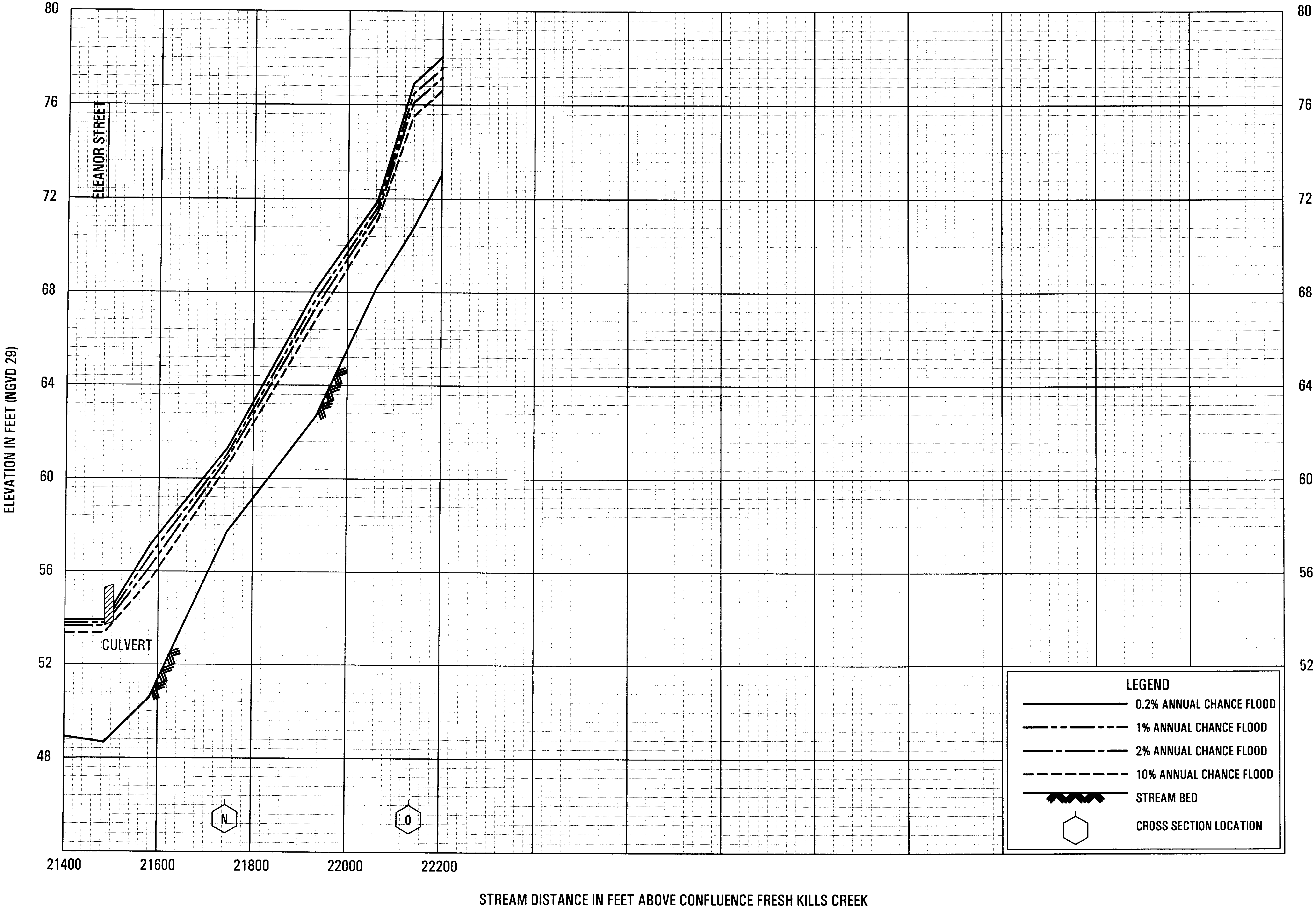


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

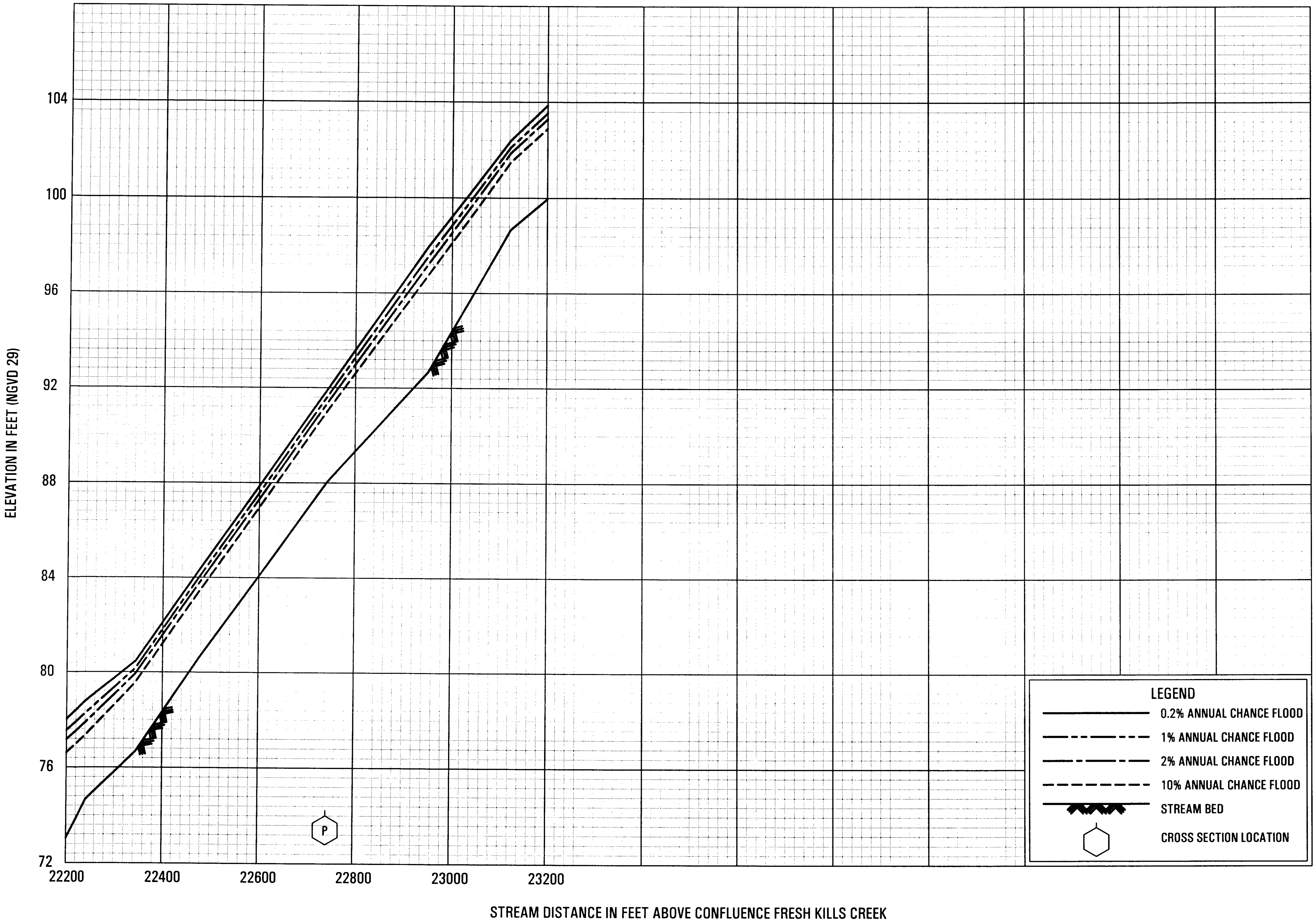


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

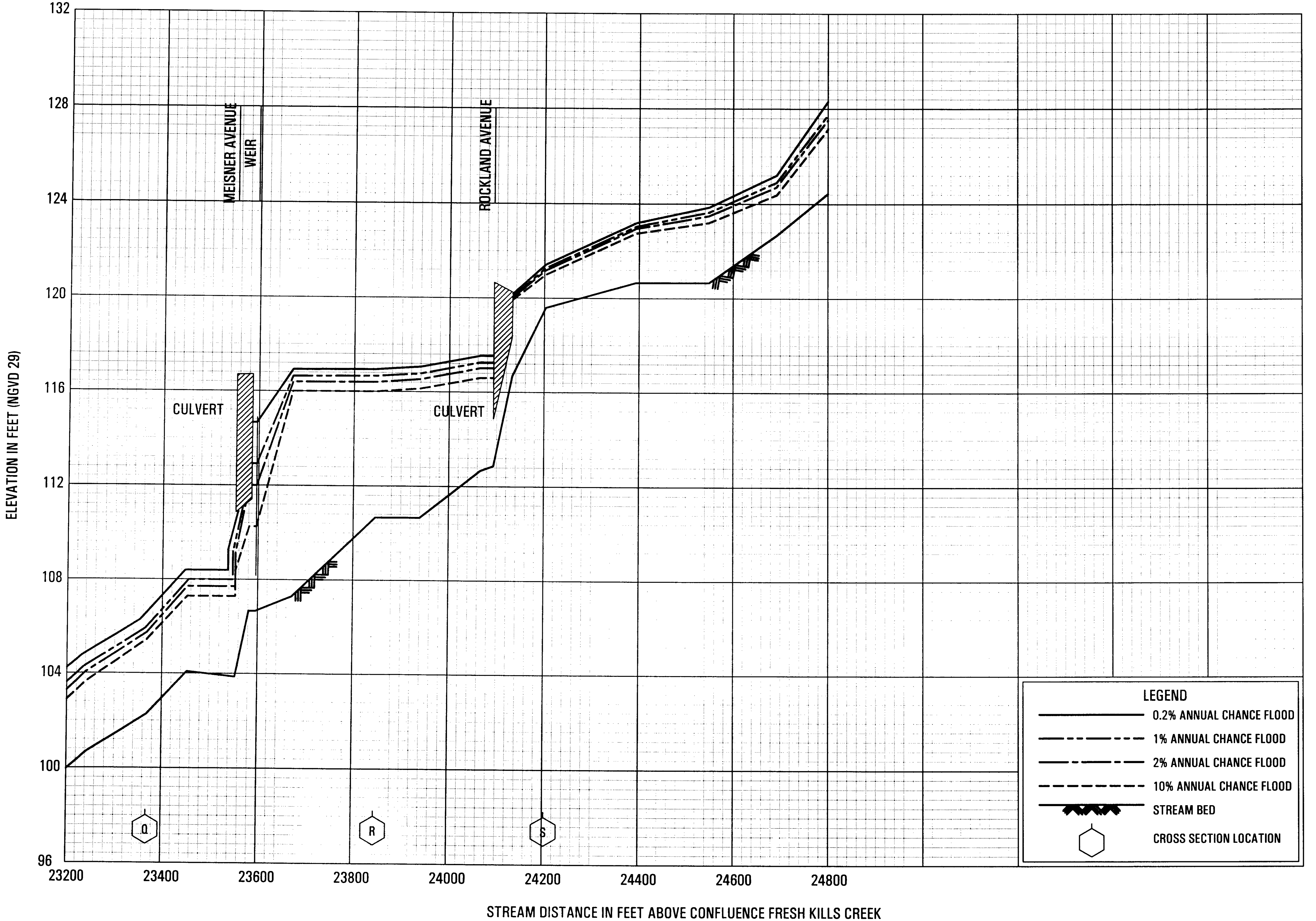


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



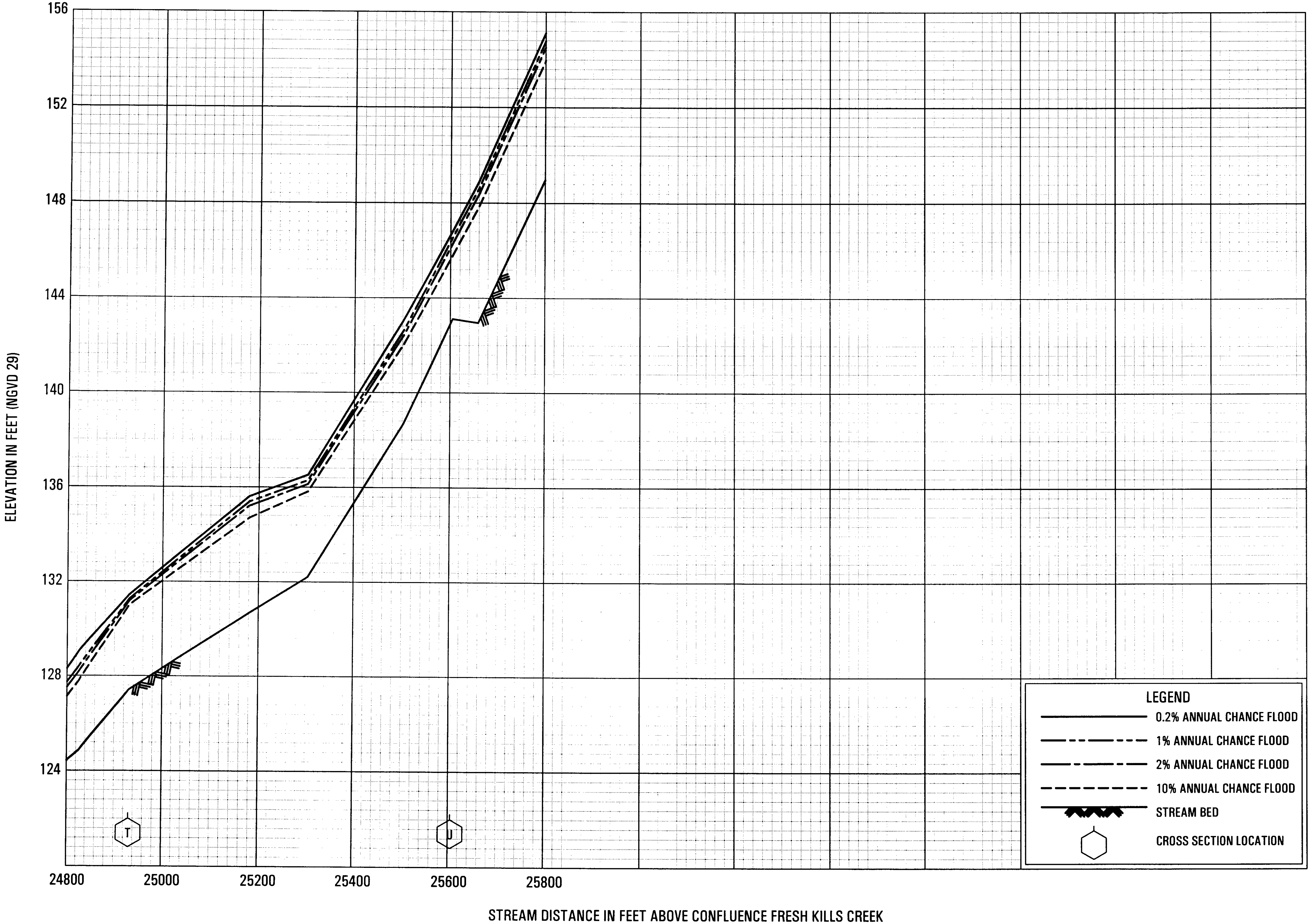
FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

35P



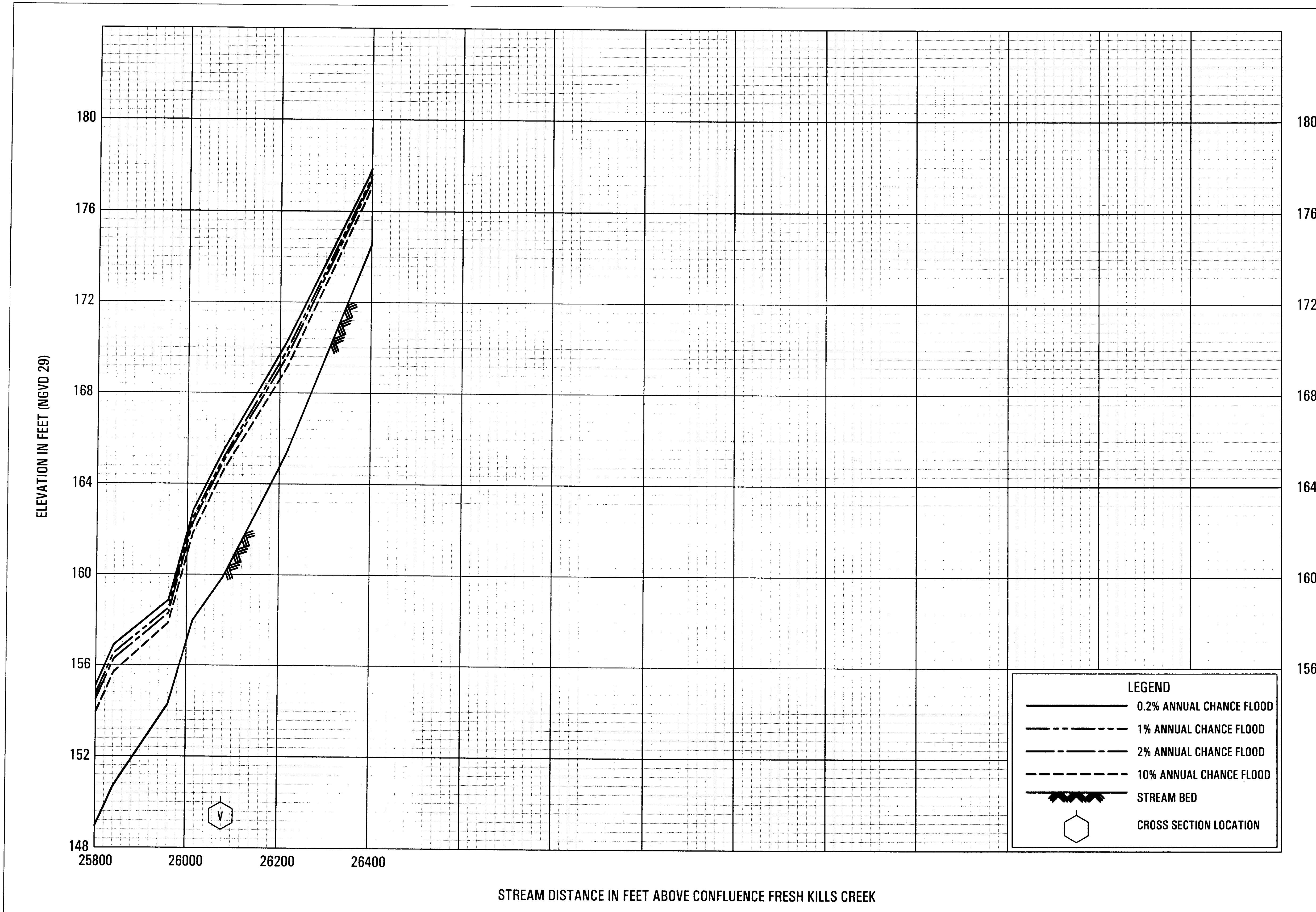
FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

36P



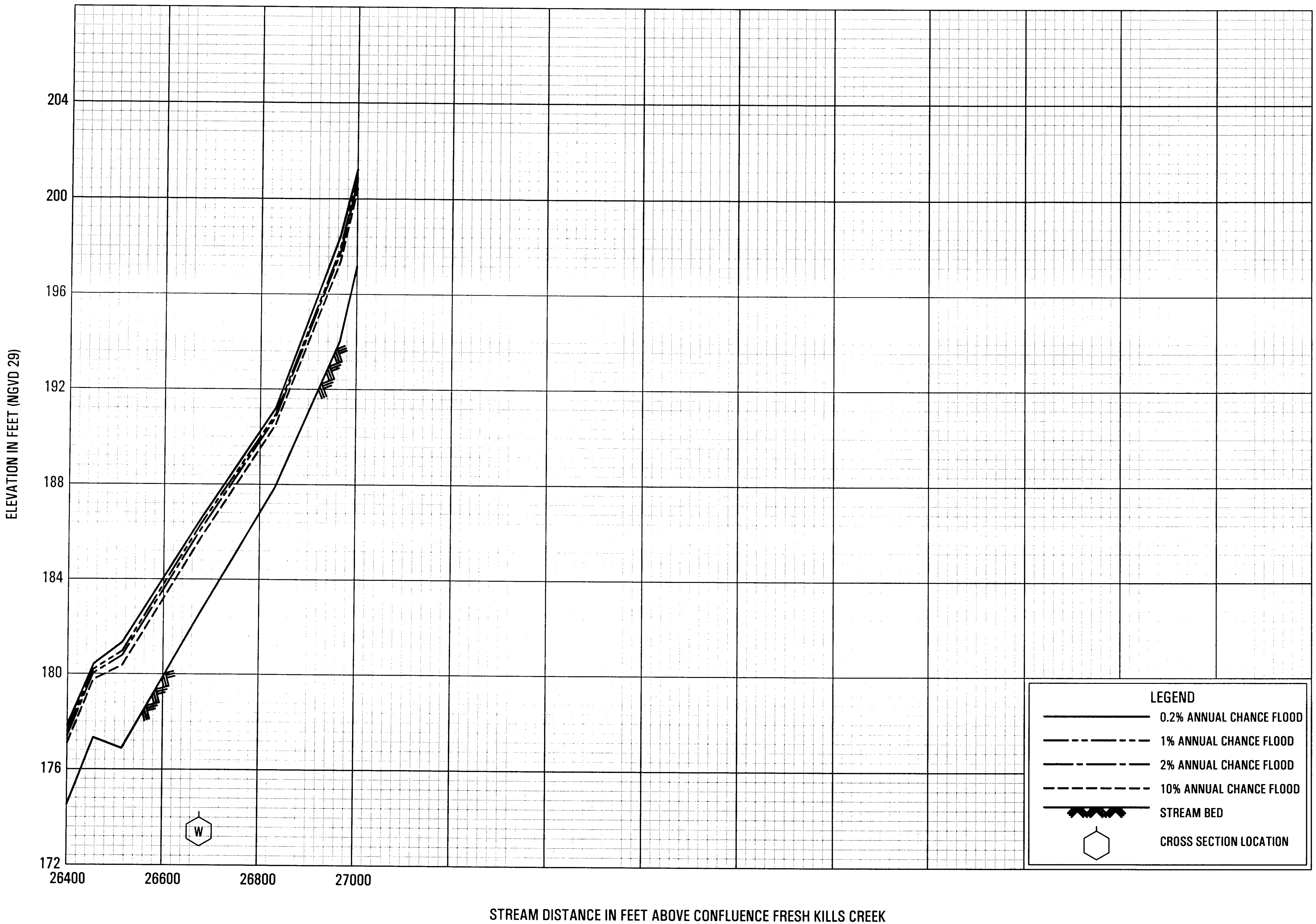
FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

37P



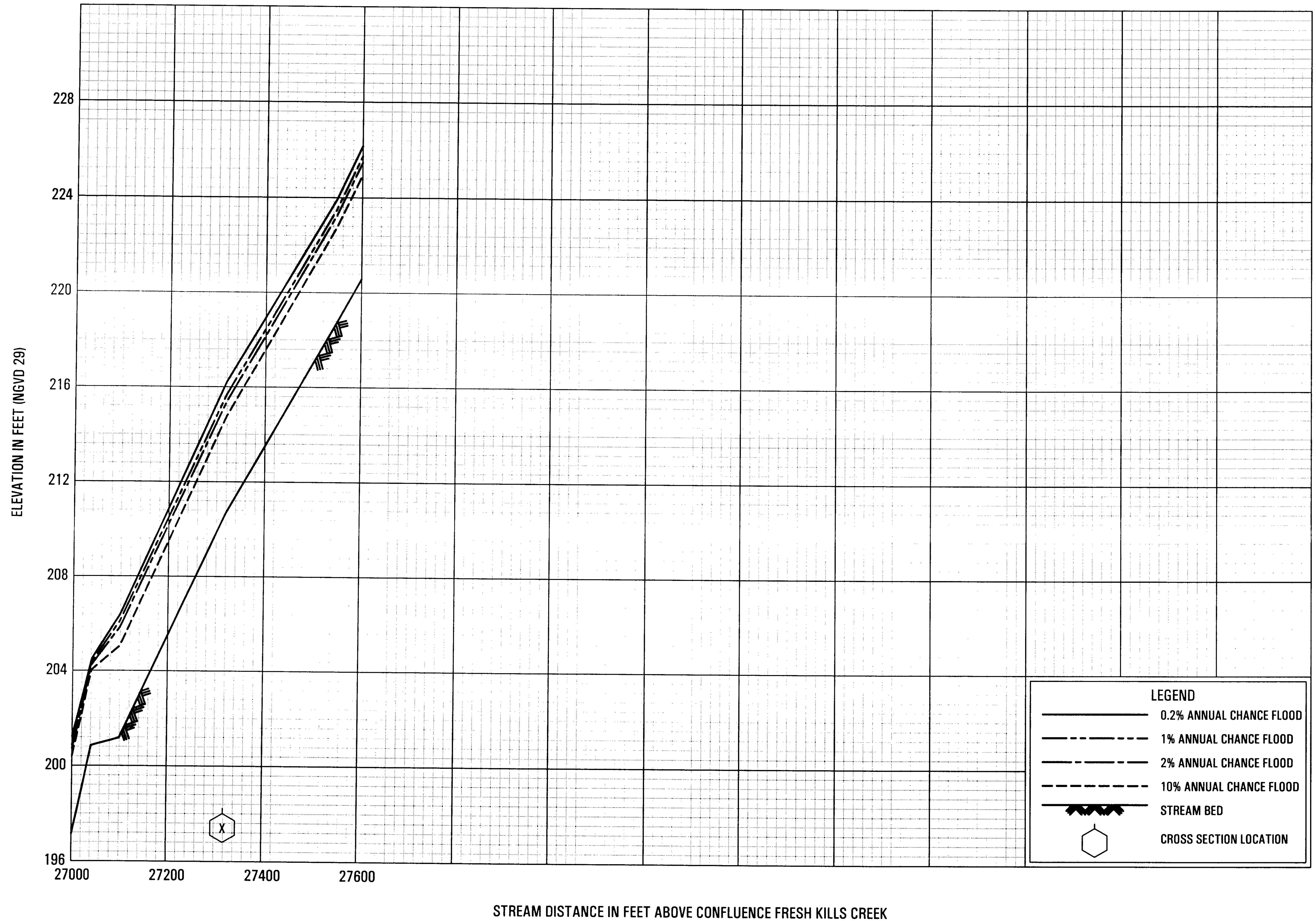
FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

38P



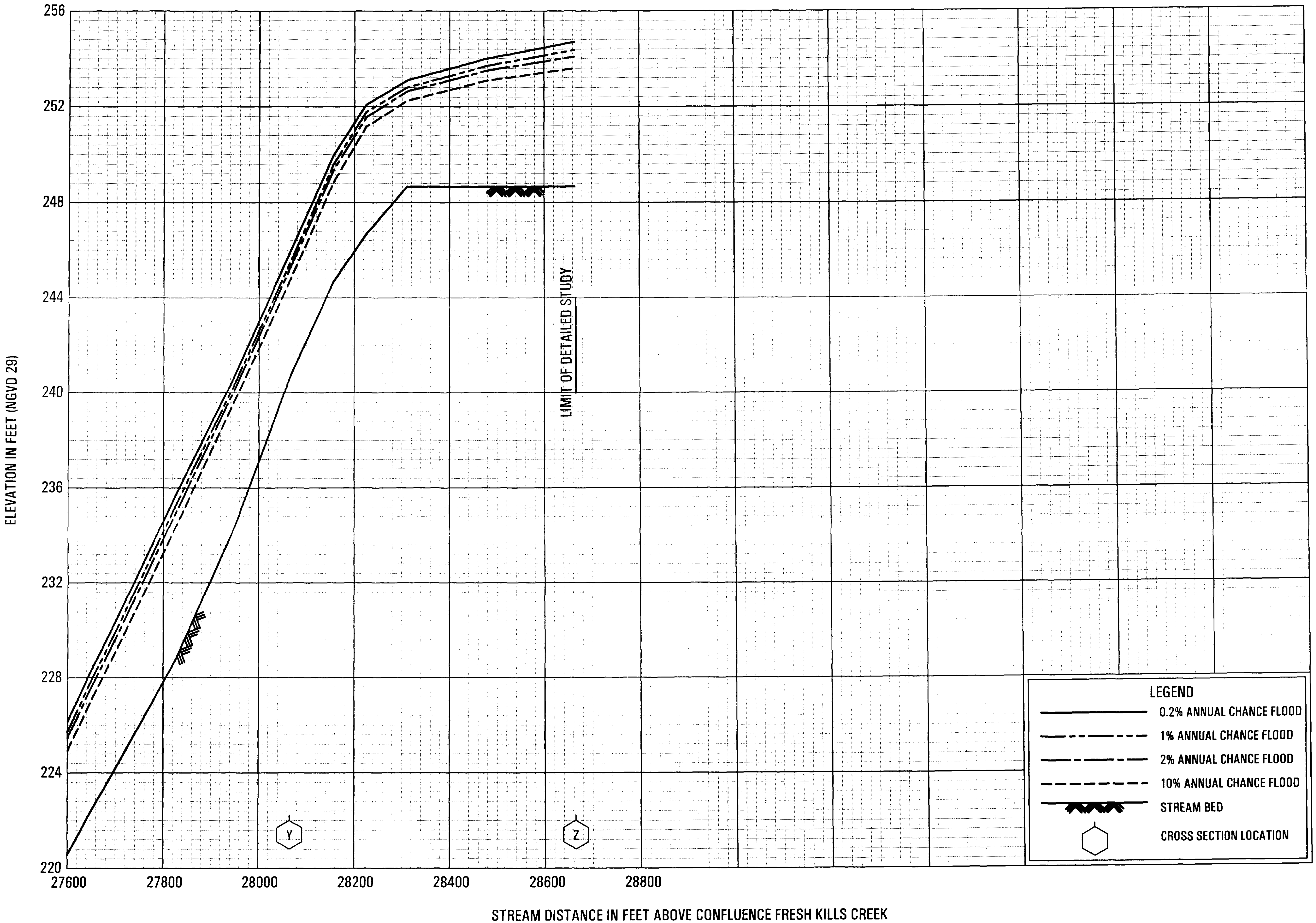
FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

39P

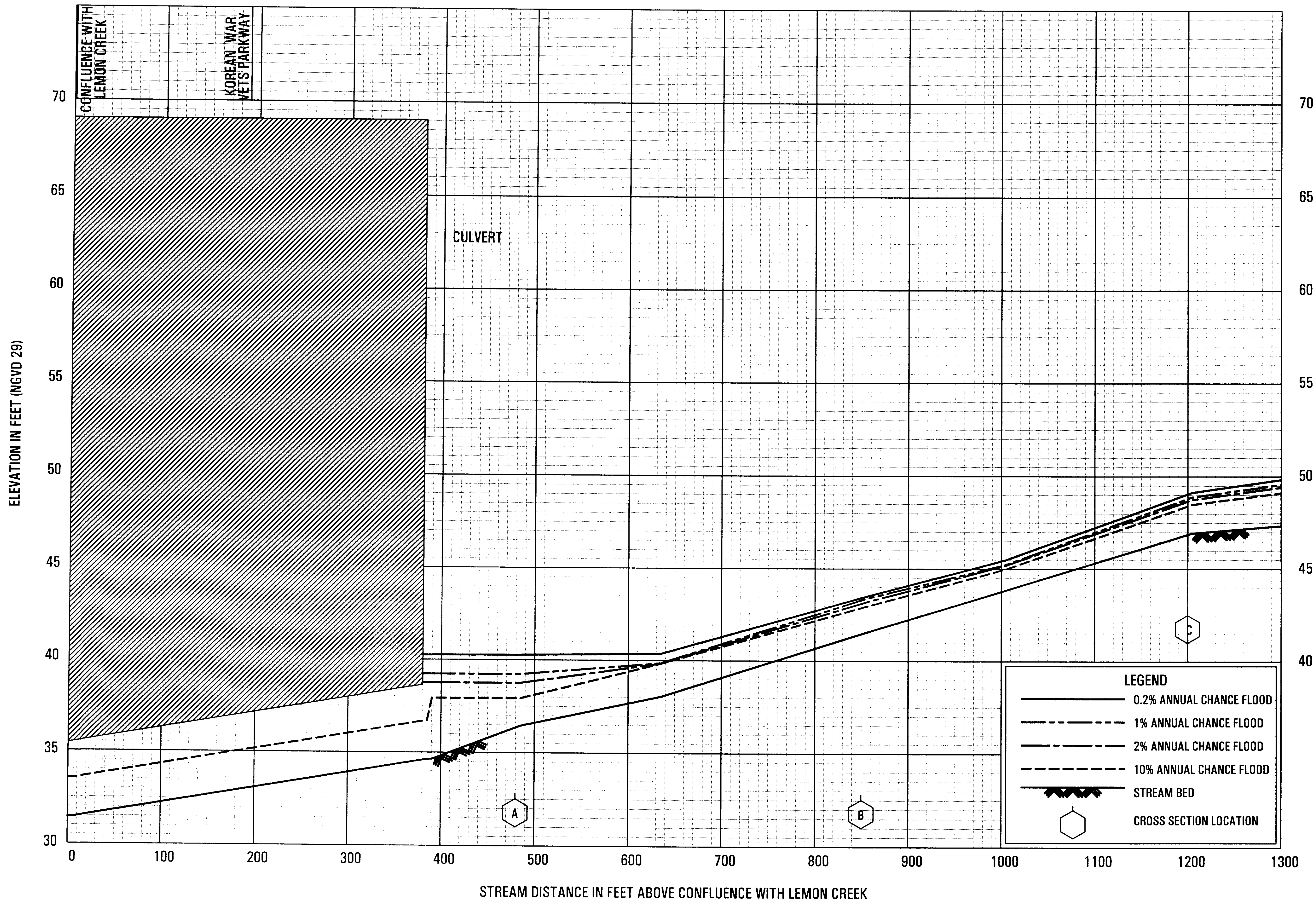


FLOOD PROFILES

RICHMOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



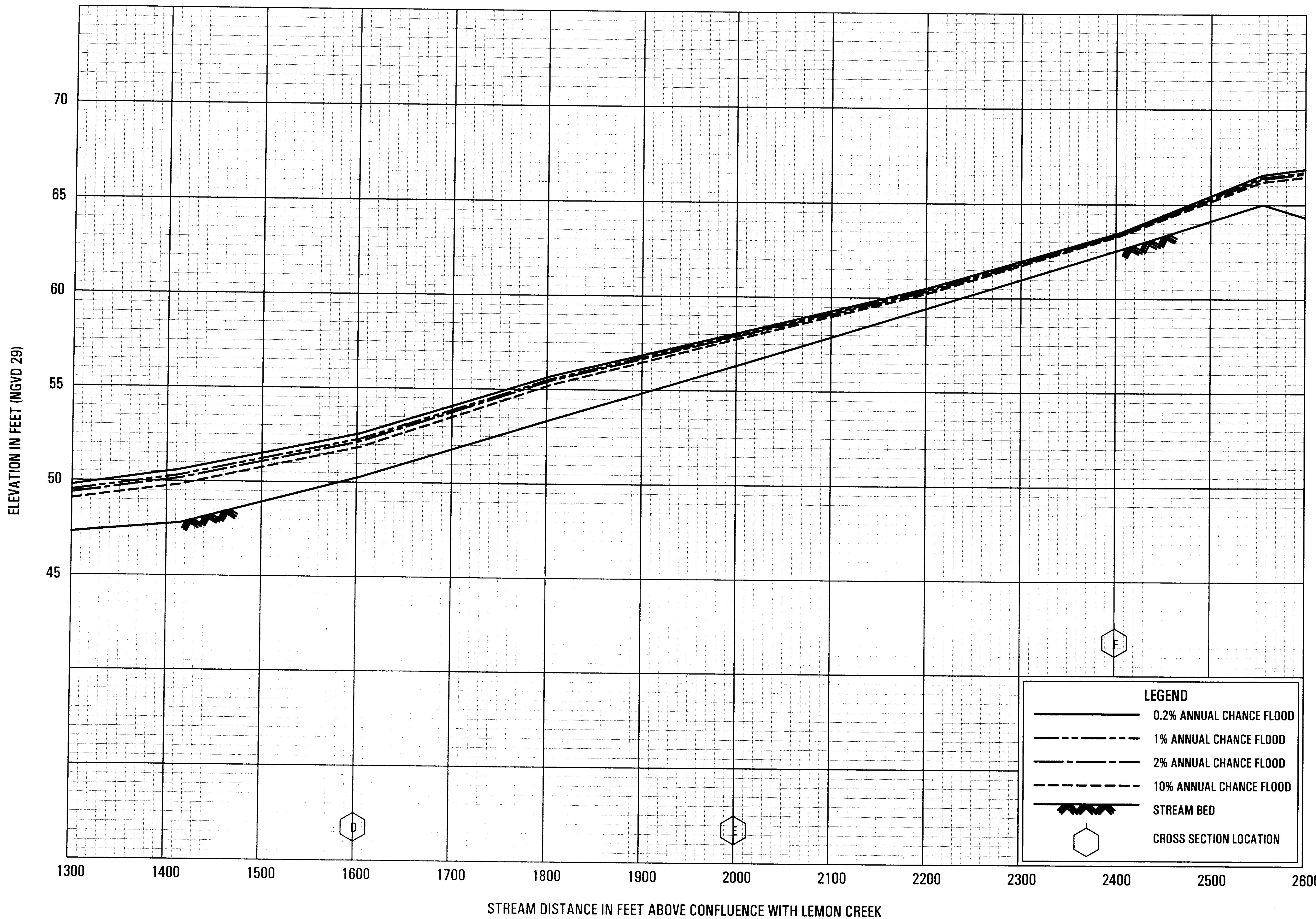
FLOOD PROFILES

SANDY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

41P



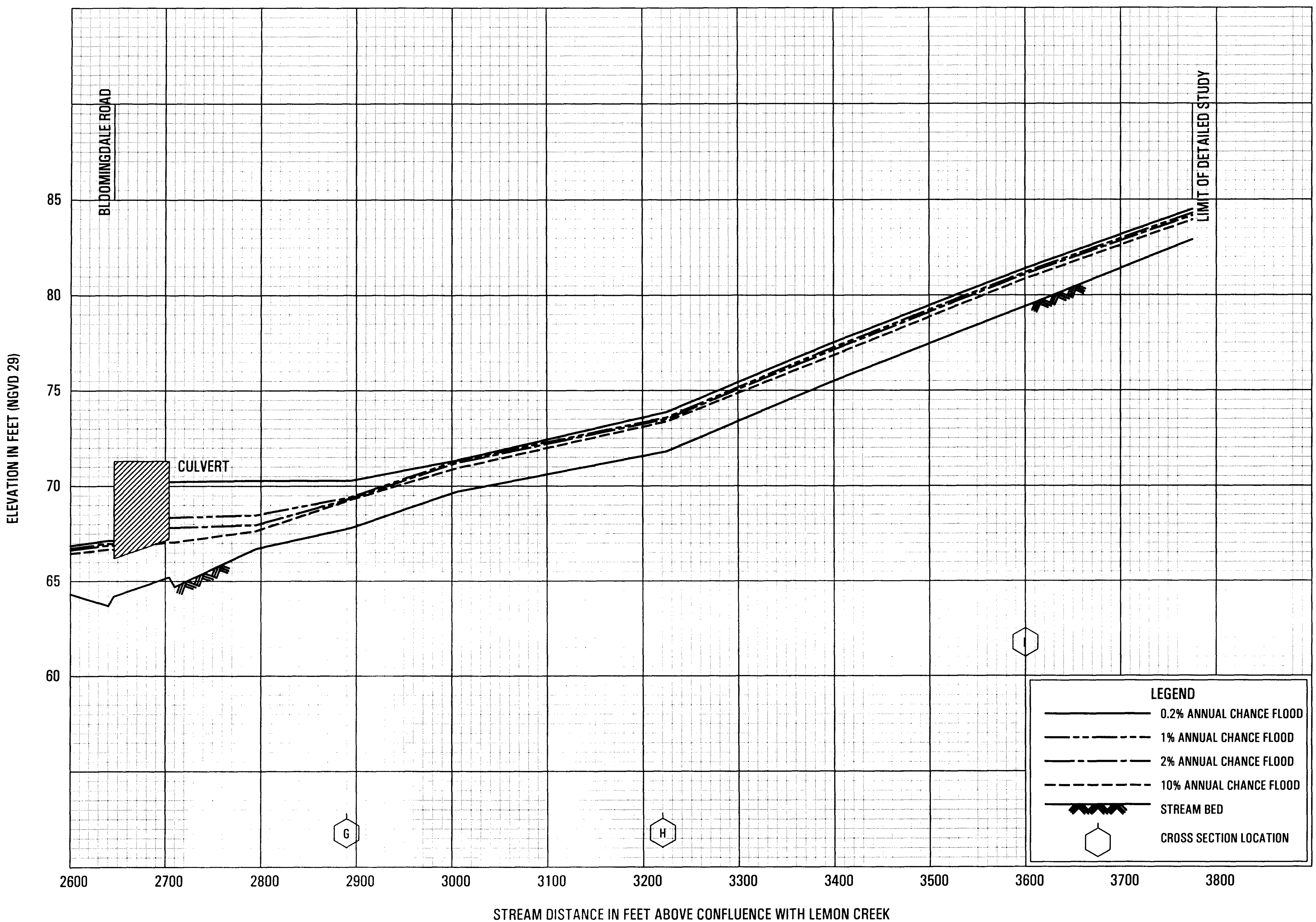
FLOOD PROFILES

SANDY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

42P

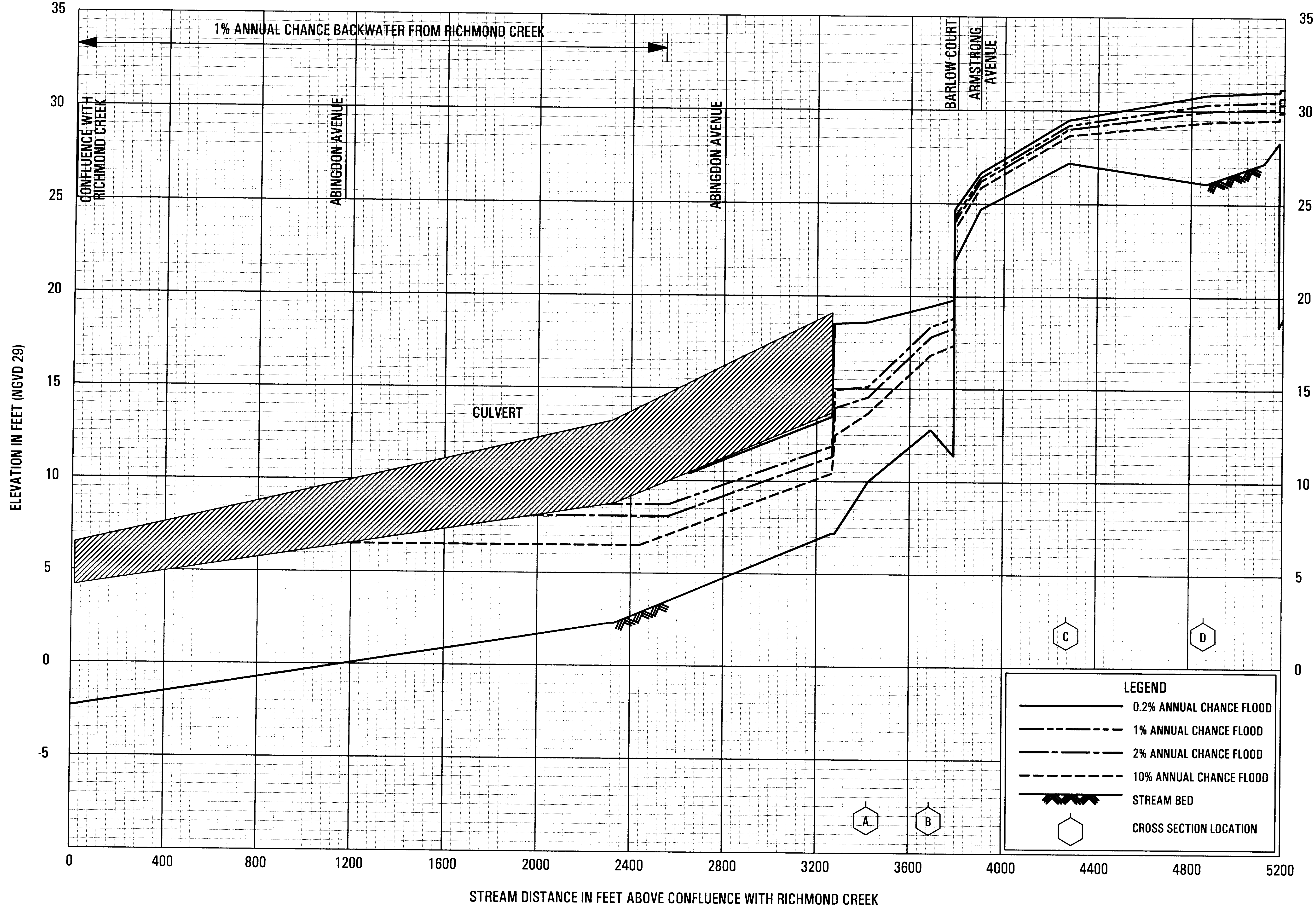


FLOOD PROFILES

SANDY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

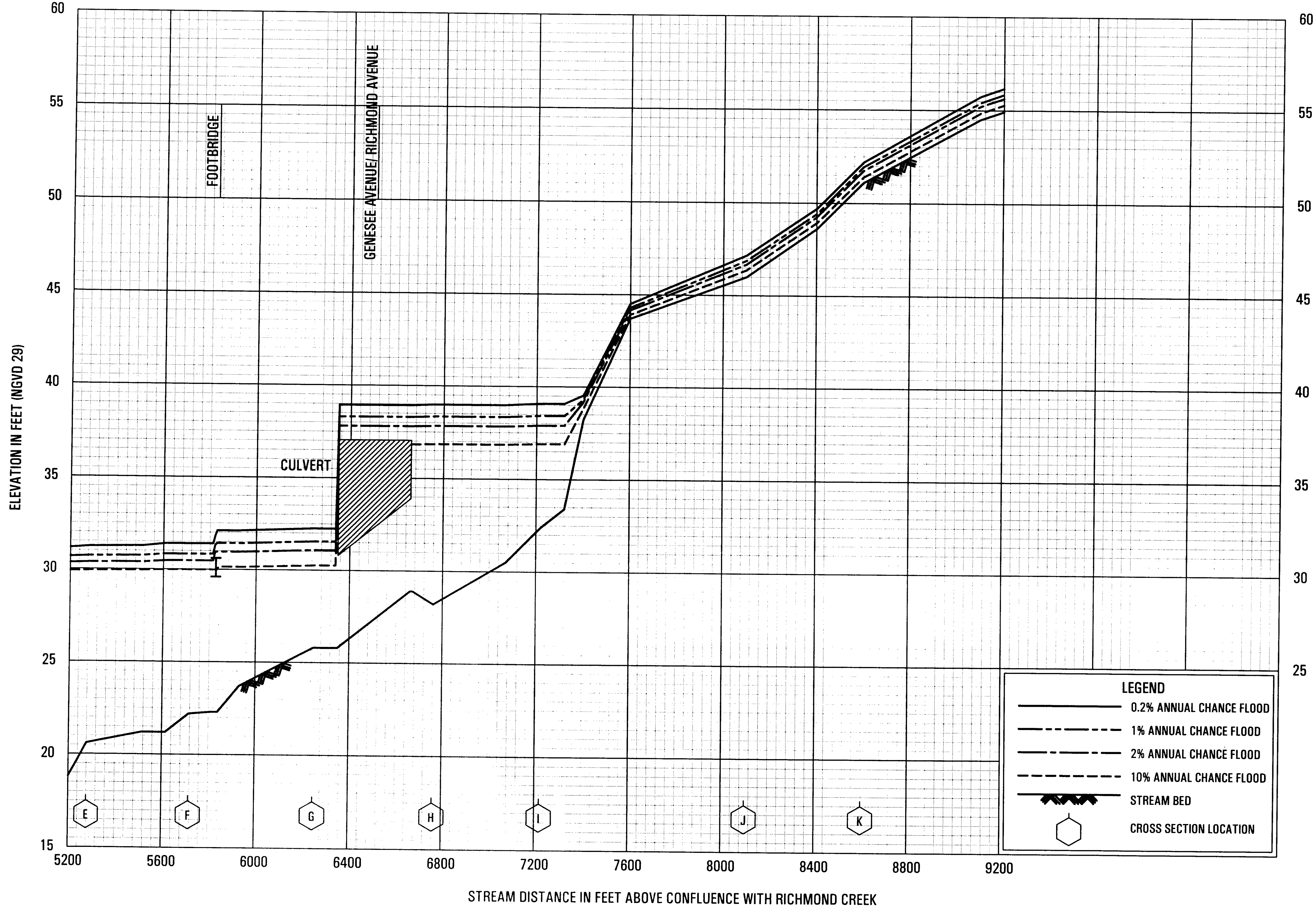


FLOOD PROFILES

SWEET BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



FLOOD PROFILES

SWEET BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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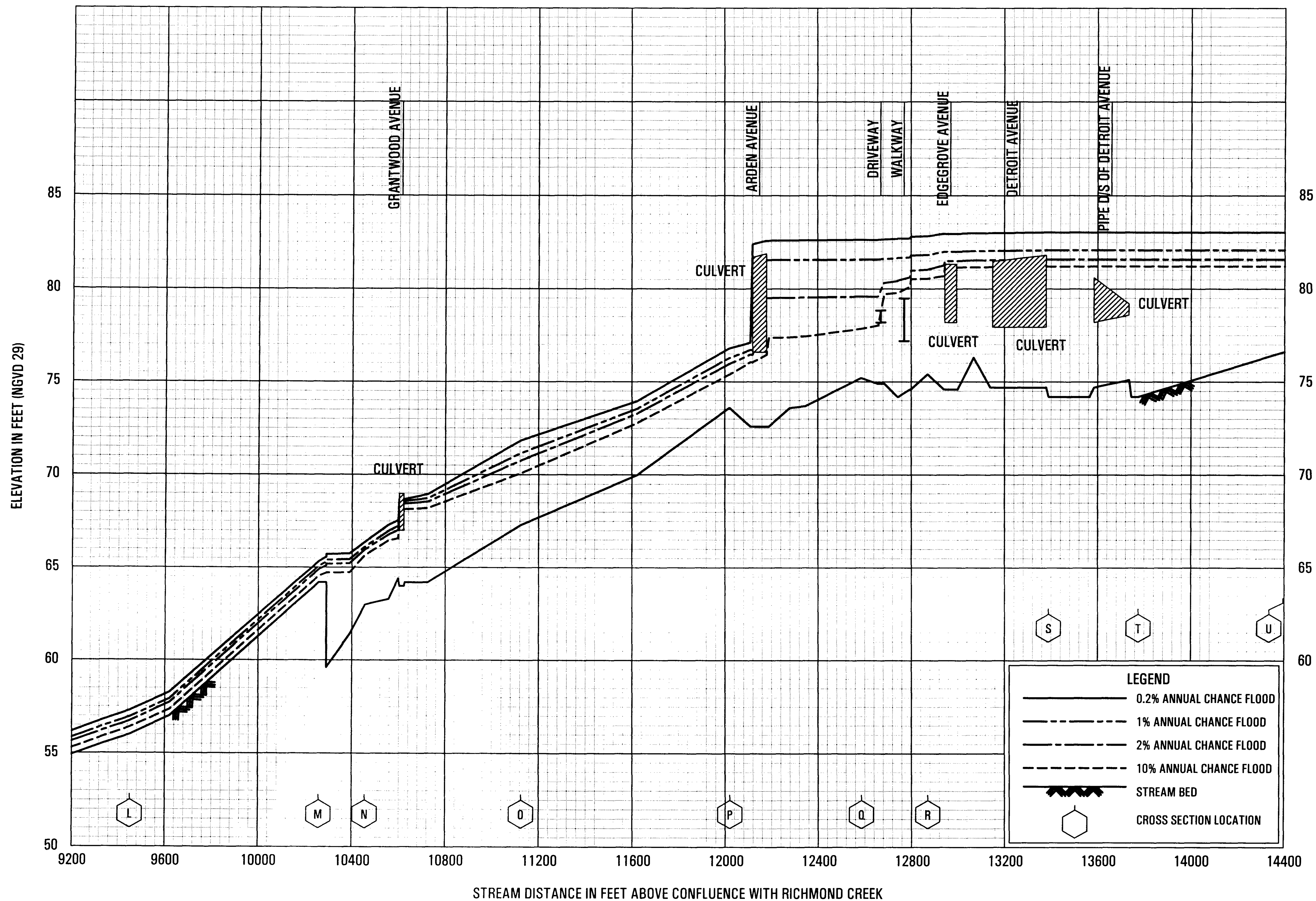

FLOOD PROFILES

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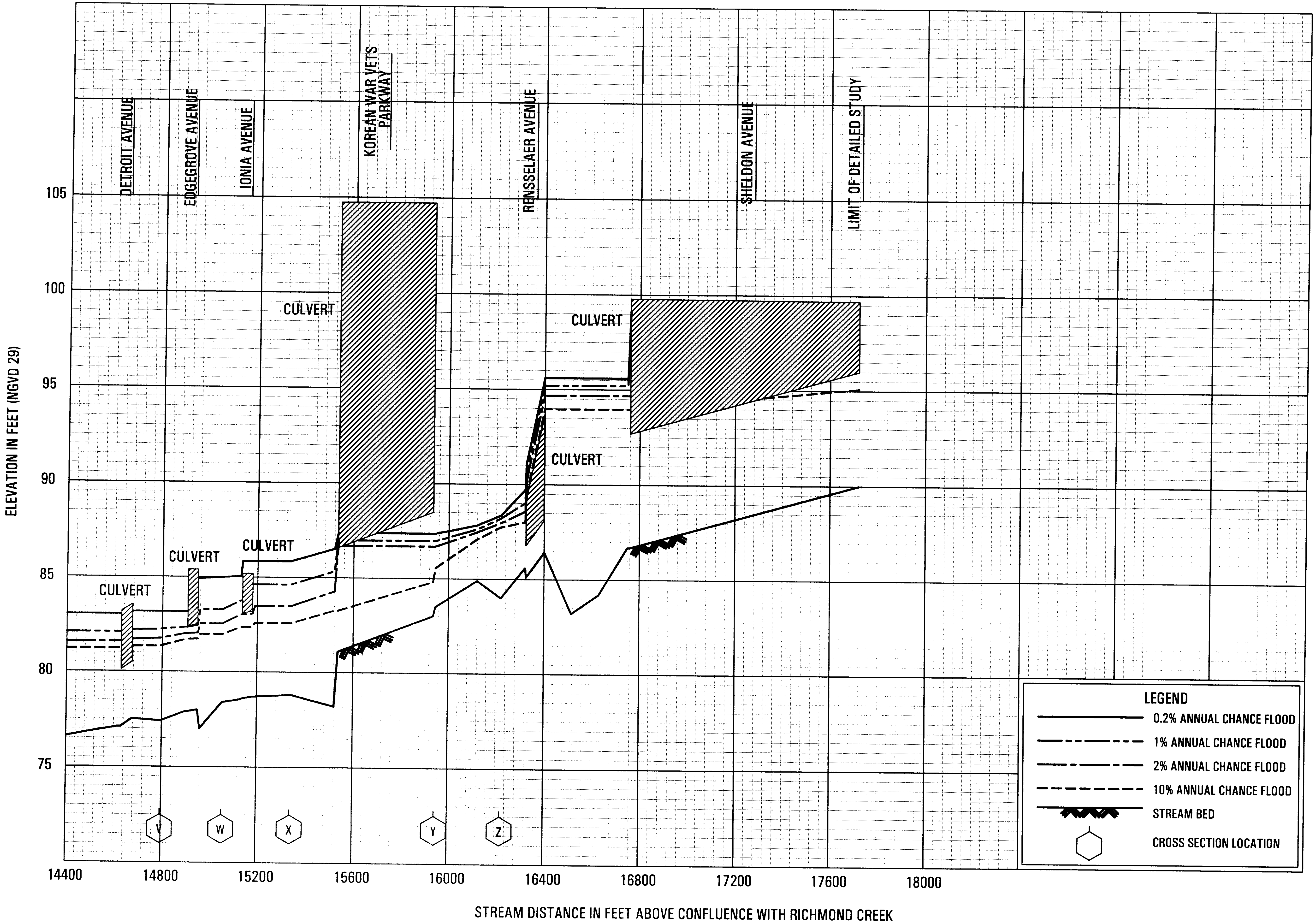
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

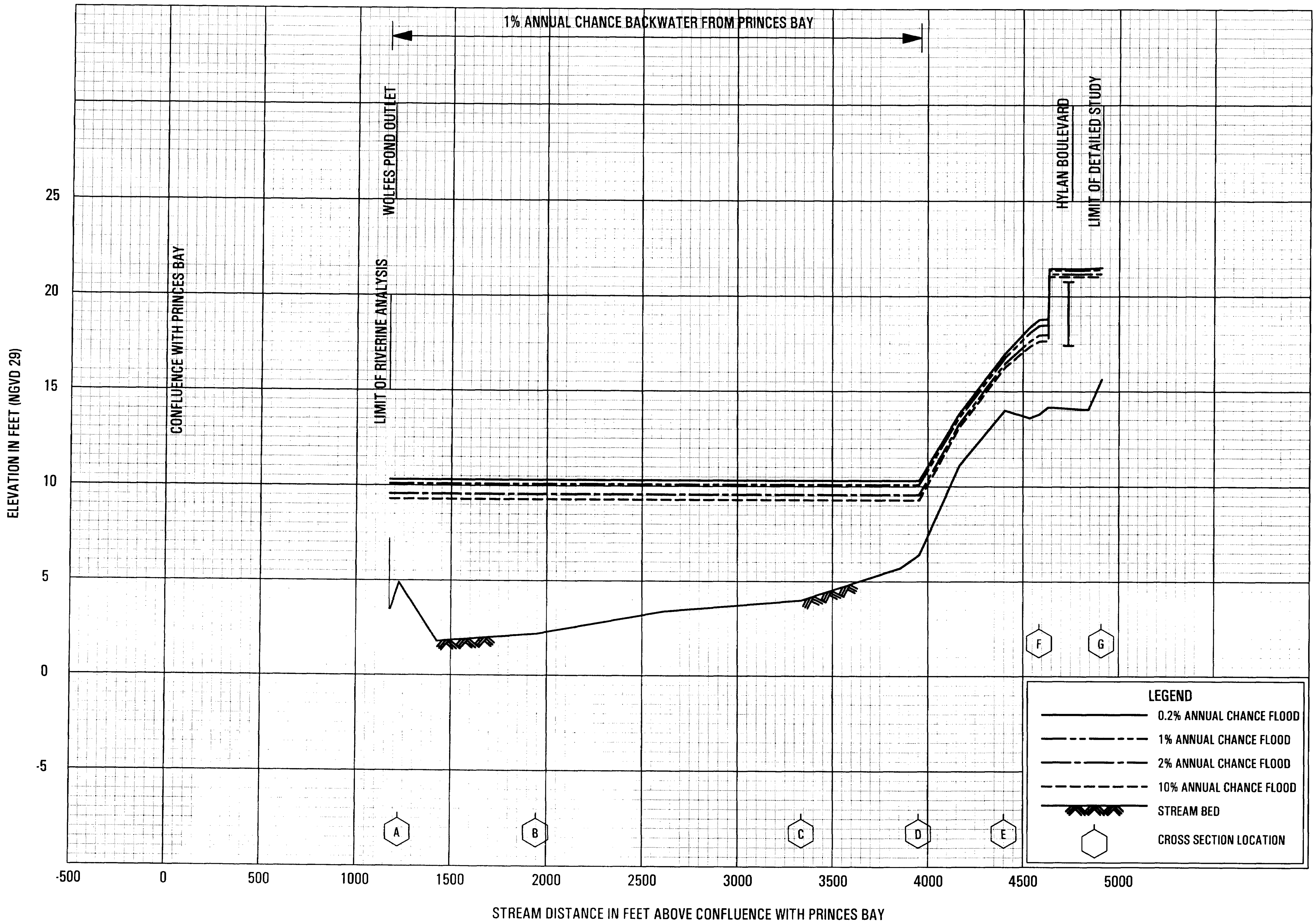


FLOOD PROFILES

SWEET BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY



FLOOD PROFILES

WOLFE'S POND

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NEW YORK, NY

48P